Rivers, Rockets and Readiness: Army Engineers in the Sunbelt

Report Documentation Page

Form Approved
OMB No. 0704-0188

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1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
1979		**00-00-1979 to 00-00-1979**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Rivers, Rockets and Readiness: Army Engineers in the Sunbelt	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Texas Christian University,2800 S University Dr,Fort Worth,TX,76129**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

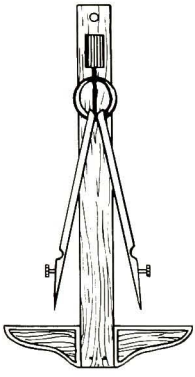
13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**216**	

RIVERS, ROCKETS AND READINESS: ARMY ENGINEERS IN THE SUNBELT



RIVERS, ROCKETS AND READINESS: ARMY ENGINEERS IN THE SUNBELT

by D. Clayton Brown

A HISTORY OF THE
FORT WORTH DISTRICT
U.S. ARMY CORPS OF ENGINEERS
1950-1975

Foreword

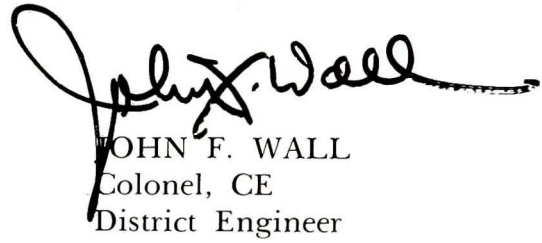
Since its founding 16 June 1775, a date that precedes the founding of the United States, the U.S. Army Corps of Engineers has compiled a history interwoven with that of our Nation. The Corps as a national resource has solved this Nation's engineering and technical problems from the beginning and will continue to do so. The impact of our interrelationship with the destiny of the United States has largely gone unnoticed since we in the Corps are content to let the record speak for itself. This is commendable, but I feel some record of the many, varied, and outstanding accomplishments of the men and women, civilian and military, professional and dedicated public servants all must be documented for the great Southwest region and for those Corps professionals who will follow. This history of the Fort Worth District compiled by Dr. Clayton Brown, Professor of History at Texas Christian University, fills this void. It is the story of our men and women who have contributed so much to the public interest of Texas, the Southwest, and the United States.

Dr. Brown painstakingly prepared this document through extensive research that included personal interviews, libraries and district files, and studies of personal papers and reports. He presents intimate insights into people and the times affecting and affected by the Fort Worth District thus far.

Measured against two centuries of service to the Nation by the U.S. Army Corps of Engineers, our 28-year existence as the Fort Worth District seems relatively insignificant. Nonetheless, this brief history from 1950 blends traditional roles and duties of the

past and present with the explosive technological advancements and requirements of tomorrow. The Fort Worth District grew from a project office of the Galveston District to today's largest combined military and civil works district in the United States. It accomplishes well a civil works mission in two-thirds of the great state of Texas and a military construction mission in support of the Army and Air Force in five states of the Southwest (Texas, Louisiana, Arkansas, Oklahoma, and New Mexico).

As we enter the final decades of the 20th Century, this history will give warm reflections of our district's achievements of the past and stimulate those who remain and follow to the challenges of the future. In my considered view, the Fort Worth District epitomizes our Chief's objectives of "Building Tomorrow Today" and "The Corps Cares." In unflinchingly accepting new and difficult missions, men and women of the Fort Worth District are the personification of our time honored motto "Essayons."



JOHN F. WALL
Colonel, CE
District Engineer

Author's Preface

This book owes its existence to the decision of the United States Army, Corps of Engineers, to have official histories written of the thirty-eight districts in the country. The Corps regarded these histories as appropriate projects for the nation's two hundredth birthday in 1976. Several had already been published when the Fort Worth District commissioned its history in 1977. So as to establish manageable dates for the project, the District requested a history through 1975, its first quarter-century of existence.

The bicentennial was a propitious time to begin a history of the District. Texas had become a leading state in the Union, ranking third in population and eighth in value added by manufacturing. The latter was particularly impressive since the state has primarily been a source of raw materials. Growth and expansion had, therefore, characterized Texas since the Fort Worth District went into operation in April, 1950. It was not entirely coincidental that the two grew simultaneously because the Corps of Engineers was the federal agency responsible for water development and flood control in the Lone Star state.

Shortage of water had plagued the state since the beginning of settlement in the early nineteenth century. Texas was an agrarian state at the beginning of the twentieth century, and although the discovery of oil in 1901 spurred her industrial development, she was still an agrarian state on the eve of World War II. But the war acted as an economic catalyst, for the area became a prime location for military posts and defense industries. Maintenance of a large defense since the war continued the flow of federal dollars into the state, and since the Fort Worth District also had responsibility for military construction not only in Texas but also in Louisiana, Arkansas, Oklahoma and New Mexico, it played a

leading role in the growth of the Southwest.

Still, the shortage of water had to be overcome, and it was this consideration that led to the creation of the Fort Worth District. Political and business leaders had won congressional approval of several major reservoirs during the war, bringing a heavy workload to the Galveston District which had jurisdiction for most of the civil works program in Texas. To lighten the workload, the Corps of Engineers created the District in 1950, and it went to work with the blessings of the public because the economic ideology of the state was rooted in development of the frontier, and ample water was a critical part of that ideology. Approximately two dozen major reservoirs and floodway projects were built during the next twenty-five years, an average of one per year.

The water supply grew and reinforced economic development. Toward the end of the 1960's, however, after Texas had emerged as an urban and industrial leader, public ideology began to change. No longer did the populace call for growth; it called for protection of the environment and questioned the impoundment of rivers and other alterations of the environment for the sake of growth. In 1973 the older ideology clashed with the new over the proposed Trinity River canal, one of the largest navigation projects the Corps of Engineers had proposed. As was the case with other projects throughout the United States, a debate occurred between the traditional developers and the new ecologists. The Fort Worth District could not, of course, participate in the discussions, but it had officially recommended construction of the canal. Defeat at the polls killed the navigation project for the foreseeable future, but the District had experienced the brunt of charges generally made by ecologists in the United States.

Ending the history at 1975 enabled the writer to review the full span of both civil and military operations of the Fort Worth District. Perhaps more important, it permitted a review of the changing ideology in Texas over water development. Texas continues to use more water, and despite the public disapproval of the Trinity canal project, the District will still have its first responsibility to meet, and it may have an expanded role in the future as the federal government via the Corps of Engineers becomes more involved in wastewater management and other

areas of environmental concern.

In researching and writing the story of the Fort Worth District, I sought to interpret the major events and their background as well as explain them. Some chapters became a straight-forward account of action, listing project after project and showing the extent and diversity of the District's work. Whenever possible, however, the projects were placed in the context of regional and national history. Whenever the occasion permitted it, differences of opinion were purposely included not only between private and public interests as in the case of the Trinity canal but also differences among the District and other federal agencies. The chapter on the Johnson Space Center exemplified the latter.

Such an approach should give the study an objectivity frequently not found in official histories, though the reader must exercise his own judgment in this regard. The mistakes of the District as well as the contributions were not ignored because no appraisal of a topic as important as federal resource management should be whitewashed. For these reasons the study was written with a humanistic perspective and not a technical one. To reinforce the humanistic perspective, a chapter on the employees was included. Hopefully, this approach will show the diversity and human element in an agency generally known for its engineering and construction feats.

Numerous individuals provided invaluable experience and time during my research, and without their help this book could not have been written. For their kindness and assistance I want to thank the following Fort Worth District employees: Geraldine Mailloux and her staff in the Office of Administrative Services; Robert Craft and his staff in the Public Affairs Office; Craig Pelz, Barbara Norman, and Ceola Williams in the library.

The following individuals in various divisions of the District furnished critical information: James Herbert, Aubrey Burkett, Lovena Deimel, Perry Robinson, John P. Shields, Max Lechter, Robert Fickle, S. J. Stovall, Dale Powell, James Bostich, Robert Gerrish, Iva Roxburgh, Juan Cantu, William Edgar, Bud Rolfe, Roland Morris, Cecil McFarland and Jack Barber.

For their help in the preparation of photographs and illustrations, I express my gratitude to J. L. Buck, Doralee Dockendorf, Josephine Lewis, Linda Sanders, Elane Lewis, and Lucille Kennedy. And to my typist, Esther Calk, I express my thanks for her patience.

I also want to thank the 459 employees who responded to my questionnaire. Several retired employees provided information that was not otherwise available, and they are listed in the footnotes and bibliography as historical sources.

Individuals at other institutions gave me the benefit of their help and advice: the reference department at the Texas Christian University library; Thomas Conger of the National Aeronautical and Space Administration; James Grimwood, historian of the Johnson Space Center; H. G. Dulaney of the Sam Rayburn library; J. B. Smallwood of North Texas State University; Claude Crowley of the Soil Conservation Service; Lowell Duncan and Dorothy Osborne of the Trinity Improvement Association; Colonel Delbert Freeman and his wife Edith; the PAO staff of the Southwestern Division; the Historical Division of the Corps of Engineers; the reference library staff at the Fort Worth *Star-Telegram;* the staff at the National Archives; the Amon Carter Museum of Western Art and the Fort Worth City Library.

To these people and still many others I express my sincere thanks. And to my wife, Kay, and my children, Carolyn and Richard, I gratefully acknowledge their sacrifice and patience.

D. CLAYTON BROWN
Texas Christian University

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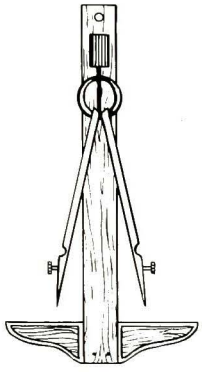
Illustrations



CHAPTER I

Flood, Drought and Economic Development in Texas

For economic development nothing is more important than wise resource management, and no resource is more essential or diverse in use than water. The history of the Fort Worth District, U. S. Army Corps of Engineers (FWD) furnishes an excellent example of resource management in Texas and within the general context of southern economic development. Though the FWD is young, starting as recently as 1950, its record in harnessing water for flood control and water supply, and to a lesser extent for hydroelectric power, must be regarded as a lasting achievement, particularly in view of the varied climate and terrain within its area of operations.

The District's responsibilities went beyond water conservation, however, and extended into military and space construction, disaster relief, recreation, and overseas construction. While practical need dictated the creation and operations of the District, the ideology of conservation was also a motivation. But proponents of conservation were responsible for criticism of the Corps and in some cases vigorous opposition. In an interrelated set of circumstances — a varied and harsh terrain, military considerations, conflicting ideologies, and public opinion — the FWD went to work in 1950 when Texas was on the threshhold of becoming a ranking industrial state. The growth of the Lone Star state as an industrial leader coincided with the District's first quarter century of operation; each was a cause and effect of the other.

To understand conservation, one must realize that weather is the most fundamental and far-reaching natural element which controls life. In the southern United States, climate according to one writer, "has been regarded as the region's *raison d'etre.*" Allegedly, because they could not endure the tropical heat of the area, colonists in the seventeenth century imported Negroes for labor and slavery was started. A long growing season with abundant rainfall accounted for the predominance of agriculture in the South. Even the characteristic southern dialect, the slow drawl, has been attributed to the energy-sapping temperature and humidity of the region.[1]

In Texas where the state's geography extends from rain forests on one side to the arid American desert on the other, conservationists faced a stiff challenge. "Texas is a wasteland," wrote one traveler, but another insisted, "Texas is a subtropical paradise." To be sure, weather in the Lone Star state is variable, probably more so than in any other state of the Union. For this reason Texans historically faced a double-edged sword with regard to weather: flood and drought.[2]

When the District was established in 1950, Texas was entering one of its worst droughts. For the next three years the state and its surrounding neighbors would experience a dry spell surpassing the famous "dustbowl" of the 1930's. By mid-summer 1953, Texas had gone thirty-six months with approximately 25 percent of its normal rainfall. In the north central area, lakes were far below normal level, and in south Texas the Rio Grande River, lifeline for cities and farms of two nations, had literally dried up. Below the city of Laredo where the national boundary usually cut a path 500 feet wide, only bedrock was visible. Above Laredo armed guards on the Mexican side prevented farmers from stealing water from the small trickle earmarked for towns. Without rain or reservoirs from which irrigation water could be tapped, crops had withered, and cattle sold for six to fourteen cents per pound, down from fifty cents per pound a year earlier. The annual tomato crop, valued at $3,000,000, was expected to be a total loss. Throughout the state mandatory water rationing was instituted; farmers hauled water for home and livestock while urban

[1] Rupert B. Vance, *Human Geography of the South* (Chapel Hill, 1935), 351.

[2] Rubert N. Richardson, *Texas, the Lone Star State* (Englewood Cliffs, New Jersey, 1958), 2-5.

residents watched their lawns and shrubs wither.[3]

Drought had always been a part of Texas life and culture. Indians used to hold special ceremonies to entice their gods to send rain. In some tribes men would perform a snake-handling ritual, complete with several writhing rattlesnakes draped on their neck and shoulders. The reptiles were prayed to, danced to, sung to, and sprinkled with sacramental meal. Tribesmen believed that only snakes could carry messages to the gods, and this ceremony, terrifying to white men, would end when the Indians released the snakes on the ground and let them crawl into their dens.[4]

White men also prayed for rain, and some had an art of interpreting omens to predict rain. During severe droughts ranchers held pray-for-rain vigils in their homes and churches. For the secular-minded, cloud-seeding was tried, but it never worked. Dry spells would cause Texans to revive the art of reading omens for favorable weather. If one saw four buzzards flying symmetrically at the four corners of the compass and another directly overhead, the drought would allegedly end.[5]

Evidence of prolonged drought was seen in more than the measurable loss in cattle and crops. Hopelessness seized many ranchers and farmers, and they left the land when they could not make their mortgage payments for lack of rain. In rural communities weather and soil always dominated life, but a drought forced the inhabitants into a state of inactivity because work, community affairs, and future plans had to wait for rain and the new start it would bring. "Drought, like other soul-searing experiences," wrote J. Frank Dobie, "tempers a human being."[6]

However severe and frequent drought struck Texas, floods were more dramatic and received more attention. They also cost lives. Fort Worth experienced a flood in 1949 that demonstrated the extent of flooding in the state and the opportunity available for water management. The incident was partly responsible for the creation of the Fort Worth District.

In May, 1949, severe thunderstorms dumped heavy rains on

[3] *Life* (July 6, 1953).
[4] Albert N. Williams, *The Water and the Power* (New York, 1951), 8-10.
[5] J. Frank Dobie, *Coyote Wisdom* (Austin, 1938), 177.
[6] J. Frank Dobie, *Cow People* (Boston, 1964), 180.

Texas and spawned tornadoes that struck several cities. On May 16 a tornado hit Amarillo, and the next day when the storm reached Fort Worth, it rained eight to twelve inches in less than twelve hours. The watershed of the Clear Fork of the Trinity River, extending through the city's southwest sector and downtown, received a deluge. Eight inches fell at Cresson and Burleson, two small towns on the southwest side. The heaviest amount came at Kennedale where twelve inches were reported. Other parts of the area escaped the deluge; some communities reported only showers. But the Clear Fork was out of its banks in a matter of hours, and "cowtown" was flooded. It was the city's worst flood since 1908.[7]

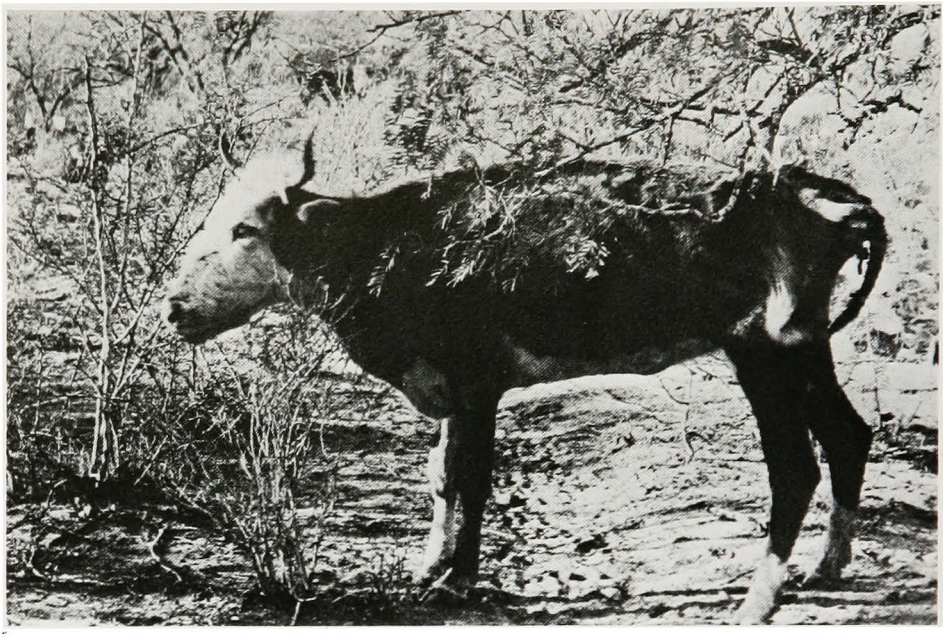
"Water lapped at the roof of rambling ranch style homes, cars drowned in water, and electric refrigerators floated on their sides," reported the Fort Worth *Star-Telegram*. The flood waters began near the edge of downtown at the west end of the Seventh Street bridge where it was ankle-deep, but within a few yards the water was over one's head. White Settlement Road was under four to ten feet of water. Particularly dramatic was the sight of the landmark Seventh Street Montgomery Ward department store where water splashed through the second-story windows. The popular white building rose out of the water like a structure from the lost city of Atlantis. Store employees spent one night on the upper floors until rescue boats took them to safety. Loss of property far exceeded the previous record set in the 1922 flood when damage was set at $3,000,000. Loss of lives reached nine by May 20, and the city waited while the father of two-year-old Rene St. John searched for his daughter after she disappeared two days earlier. Mr. St. John found his baby's body tangled in debris, and the body count stood at ten.[8]

Sewage and water treatment plants were flooded, and pumping stations could not handle the load. A giant pump broke down at the Holley Station, the major water treatment plant in the city. Short of drinking water and afraid that typhoid might break out, the water department sent a special order to Indianapolis for a new General Electric 15,000,000 gallon pump. Truck driver Victor Brown drove 1,000 miles in 33 hours to deliver the device. So critical was the pump that he was escorted through Oklahoma

[7] Fort Worth *Star-Telegram*, May 16-18, 1949.
[8] Ibid., May 20, 1949.

An ominous dust cloud on the Texas plain. (Courtesy of U.S. Soil Conservation Service)

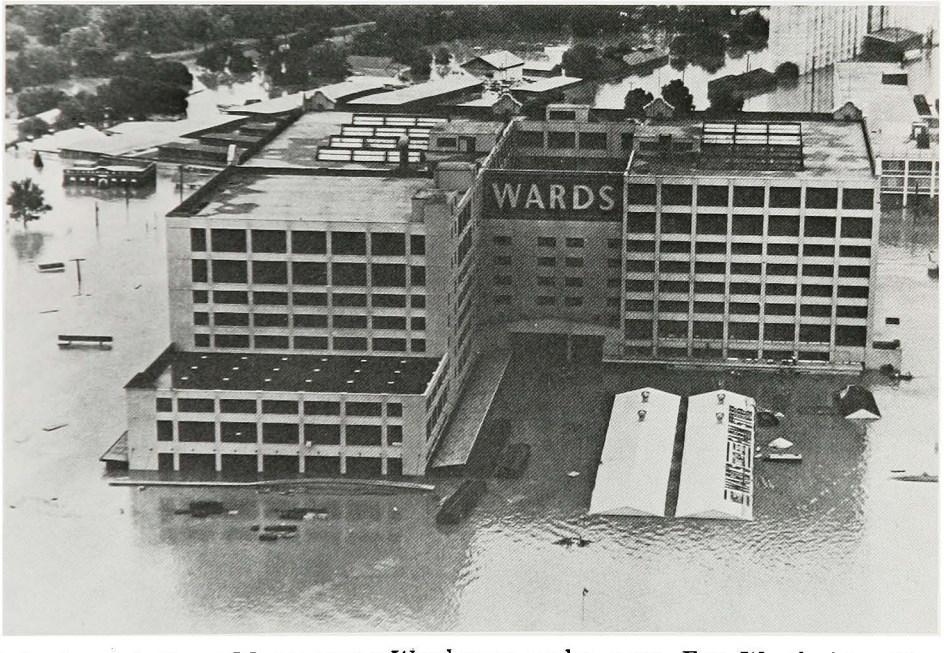
Effects of drought on Texas farmland. (Courtesy of U.S. Soil Conservation Service)



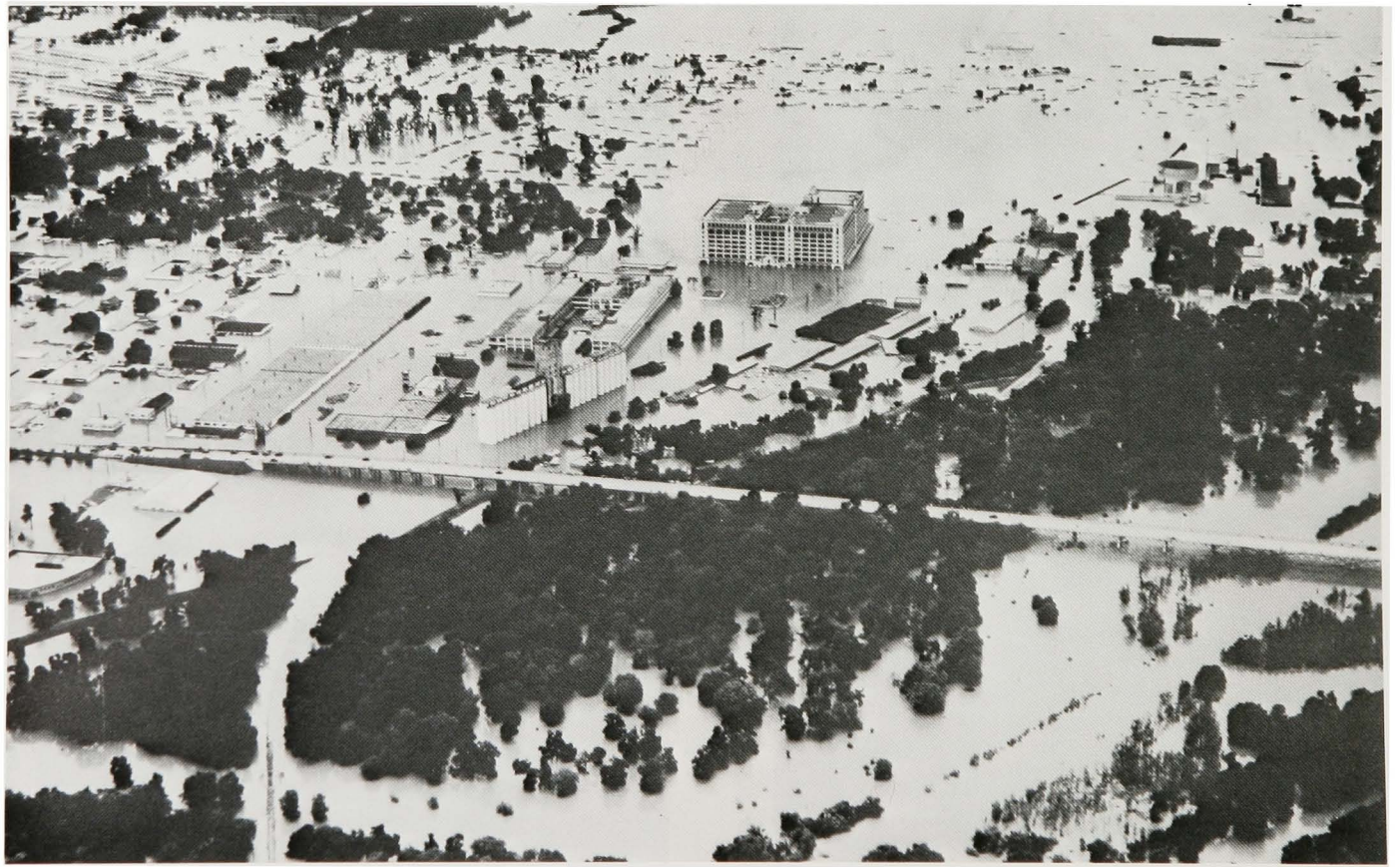
Drought-starved Hereford cattle, West Texas. (Courtesy of U.S. Soil Conservation Service)

Drought drove people from the land, circa 1935. (Courtesy of U.S. Soil Conservation Service)

Downtown San Angelo flood, September, 1939.



The Seventh Street Montgomery Ward store under water, Fort Worth, May 17, 1949.



Aerial view of Fort Worth flood, 1949.

by the highway patrol, and at the Denison bridge on the state boundary, the Texas highway patrol took over and continued the high speed escort to Fort Worth. Brown received a hero's welcome when he drove into the city.[9]

Ironically the Corps of Engineers was constructing the Benbrook dam and reservoir on the Clear Fork when the flood hit. Water had swept through the still open channel, but caused little damage to the uncompleted earthen dam. District headquarters of the Corps in Texas was at Galveston, and Colonel B. L. Robinson, District Engineer, came to Fort Worth and immediately assured the city that the Corps would repair all levees damaged by the flood. The city of Fort Worth had constructed the levees years earlier, but they broke under the immense pressure. James Cotton, engineer in charge of the Fort Worth suboffice of the Galveston District, had already put his men to work. C. F. Swenson, assistant to Cotton, had men marking stakes along the high water line of the river. Anton McGill, engineer in charge of levee operations at the suboffice, located cracks and fissures in the levees. Other crews took readings on the maximum flood discharge of the Clear Fork's tributaries. From Washington, D. C., the Corps sent H. R. Norman and R. W. Huck, assistant to the Assistant Engineer in Washington, to inspect the flood. James H. Boykin and Cotton joined them in an aerial survey of the city and its environs.[10]

The most immediate problem was the repair of the Clear Fork levees, and the Fort Worth suboffice awarded emergency contracts. To speed repair the suboffice required contractors to guarantee overtime and also night crews. Each contractor had only twenty-four hours to commence operations. Colonel Robinson also intervened in order to cut "red tape."[11]

By the time the flood had passed, the loss of lives had climbed to eleven, and the property damage was set at $13,000,000. It was the worst flood in Fort Worth's history. The Corps of Engineers finished construction of the Benbrook dam in 1952; heavy rains came again in 1957, ending another prolonged drought, but the newly built dam and channel improvements of the Clear Fork and West Fork prevented flooding. It was estimated that

[9] Ibid.
[10] Ibid.
[11] Ibid.

$9,257,000 in damages were saved in 1957 alone.[12]

The Fort Worth flood of 1949 served to illustrate the general problem of flooding in Texas. "Many of the greatest flood discharges," wrote one scientist, "occurred in East-Central Texas."[13] Tropical storms originating in the Caribbean or Gulf of Mexico often achieved their maximum intensity at the Balcones Fault, some 200 miles inland from the Texas coast. This area has recorded some of the highest downpours in the United States, marking a contrast between parched earth and torrential rains.

Texas geography was responsible for the contrast of flood and drought. A relief map shows the state divided into three major regions: (1) the Atlantic-Gulf coastal plain, (2) the Great Plains of Central North America, and (3) the Rocky Mountain system. The joining of these physio-graphic provinces caused a variety of weather, topography, and resources. Rainfall in the eastern portion of the state averages forty inches or more per year, and at the Texas-Louisiana border fifty-five inches could be expected. El Paso, 800 miles to the west, could expect only eight.[14]

Severe droughts may be broken with severe floods. In September, 1952, central Texas experienced a flood after several dry years that one magazine described as a "hydrologic manna." Under such conditions soil erosion is excessive, and sediment deposits reduce the life of reservoirs. The most outstanding Texas floods on record when the FWD was established had occurred in 1884, 1900, 1908, 1913, 1921, 1932, 1935, 1936, 1938, 1939, 1940, 1945, 1946 and 1949. The principal flooding rivers were the Brazos, Trinity, Colorado, Nueces, Neches, Guadalupe, San Antonio, Sabine and Rio Grande.[15]

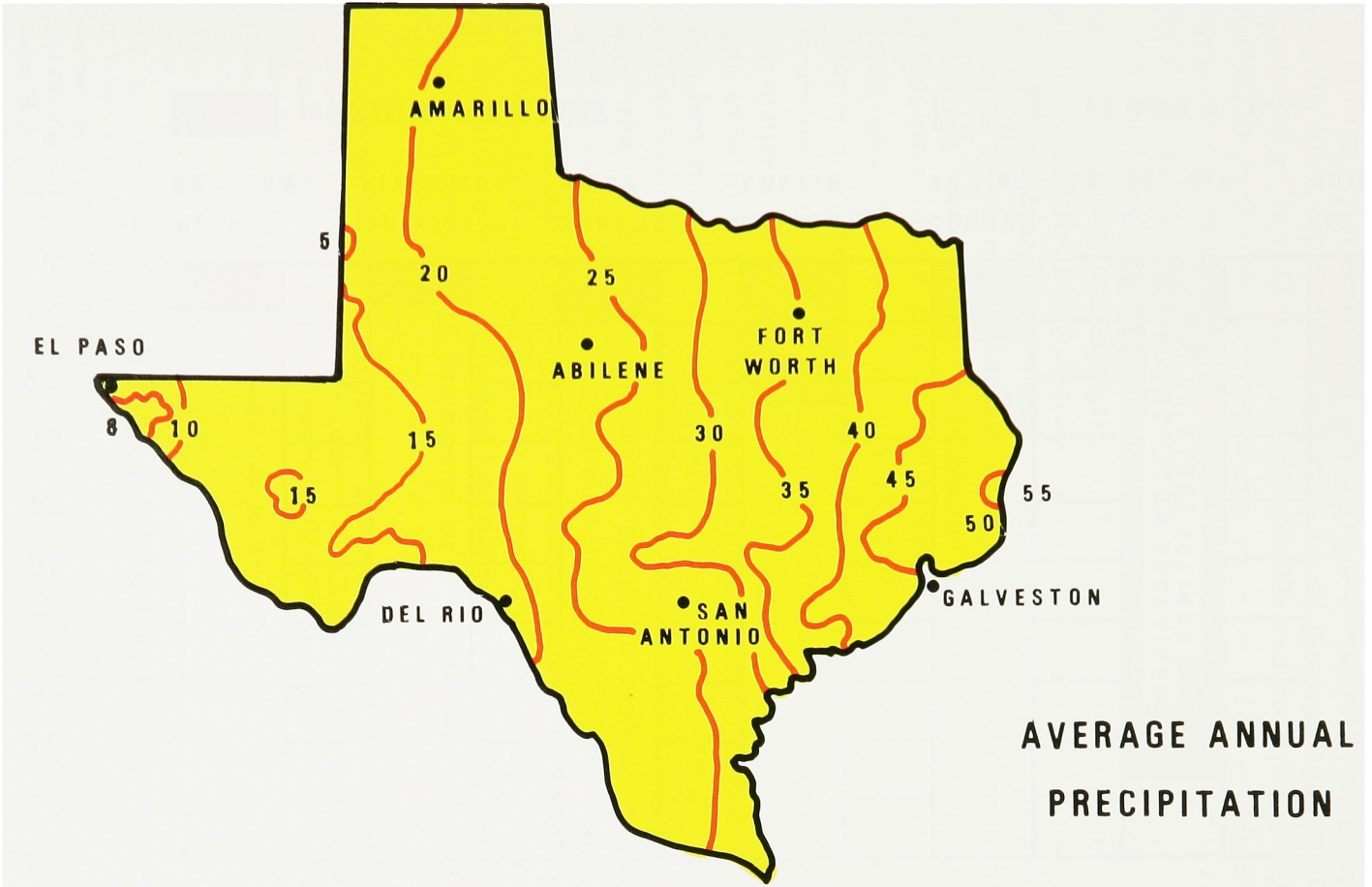
Natural geography thus hindered the economic development of the state. Until control was established over Texas' rivers, vast acreages of flood plains were either unsuitable for cultivation or constituted a high economic risk. Ironically, lack of water had begun to retard development. Beginning in 1940 per capita

[12] Tarrant County Water Control and Improvement District No. 1, *A Report to the People: Your Water Supply Service*, pamphlet (1962), pp. 24-25; Seth Breeding, *Flood of May 17, 1949 at Fort Worth, Texas*, (Texas Board of Water Engineers, U. S. Dept. of the Interior Geological Survey, Austin, June, 1949).

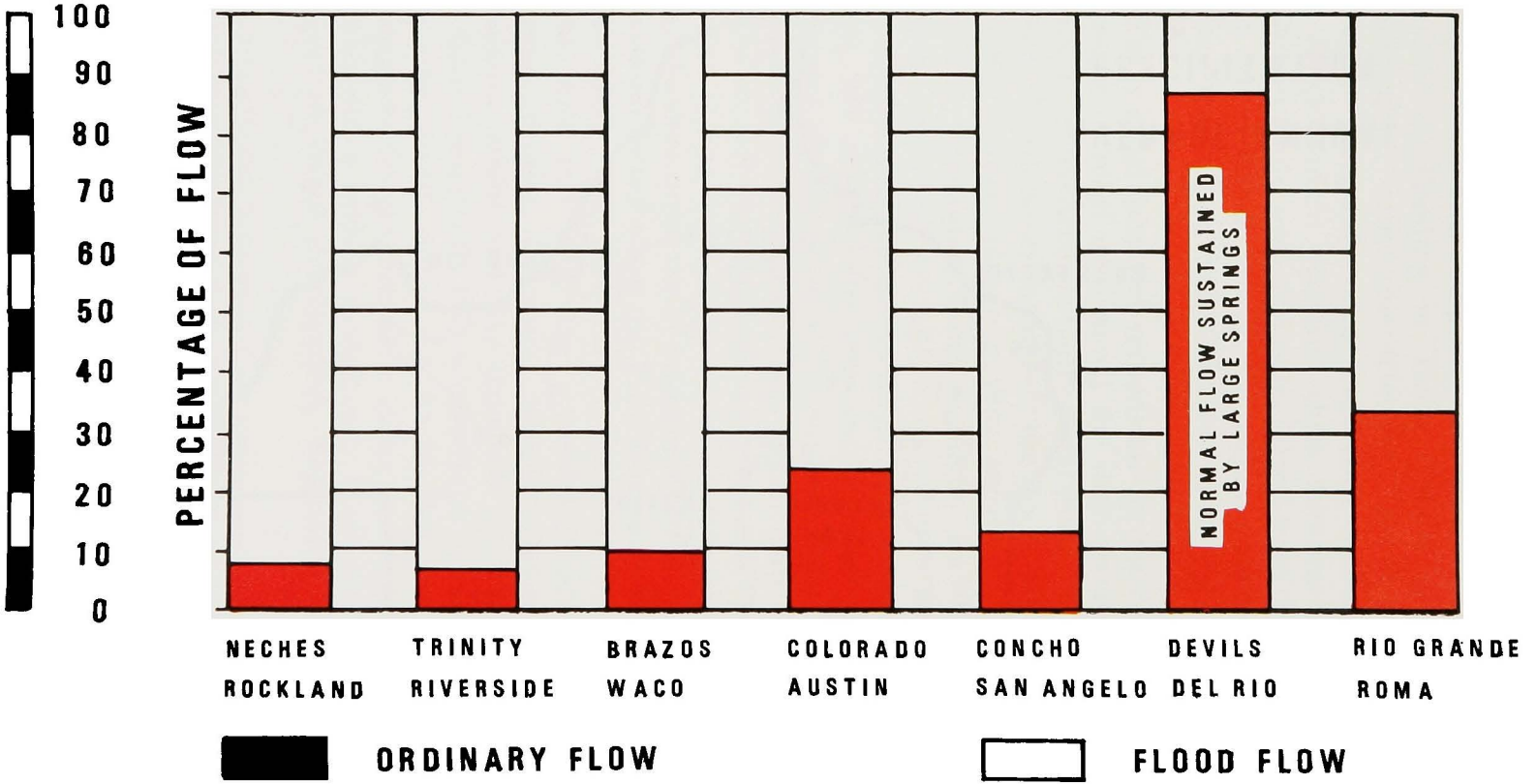
[13] William G. Hogt and Walter B. Langbein, *Floods* (Princeton, 1955), 73.

[14] Ibid., p. 296.

[15] Ibid.



Rainfall variation in Texas.



Comparison of Ordinary Flow and Flood Flow.

consumption of water took an upward trend, and as the state's population mushroomed during World War II, more water was needed. The city of Temple depended on the Leon River for water and during dry seasons the supply was inadequate. During the war the town's population grew 30 to 40 percent, and water consumption by 1945 had risen to 6,000,000 gallons daily, a 300 percent increase over its pre-war consumption. "The people of Texas are screaming for more water," wrote one citizen, and it is "needed for the further development of Texas."[16]

Normal precipitation could not meet the state's need. Natural reservoirs, underground wells, and springs were no longer sufficient, and the below average rainfalls during 1947-1948 and 1951-1952 worsened the shortage. "Unless we can find some way to lick it," wrote noted historian Walter Prescott Webb, "drought may finally set a limit to the phenomenal growth of population and industry in our part of the world."[17]

Besides the restraints imposed by nature, economic development in Texas had long suffered from a complex set of circumstances peculiar to the southern states. The South had never matched the northern states in industry or manufacturing owing to its plantation economy, the effects of the Civil War, the cotton-lien system, low wages, and related causes. As late as 1938 President Franklin D. Roosevelt had called the South, including Texas, the "Nation's number one economic problem." The wasted or neglected resources of land and water, he continued, ranked at the top of the region's immediate problems.[18] Since the Civil War the South had been an economic colony of the North, and absentee ownership, freight-rate discrimination, and profit-draining in general had contributed to the economic malaise.[19]

[16] Quote in Memorandum, Jack B. Hudson, Basin Planning Engineer, November 19, 1951, Box 2146, FWD Storage; W. Grey Draper to U. S. Army Engineers, November 17, 1945, Public Hearing, "Advisability of Improving the Leon River," November 19, 1945, Box 2135, FWD Storage.

[17] Walter Prescott Webb, "Billion-Dollar Cure for Texas' Drought," *Harper's*, CCVII (December, 1953),73.

[18] The National Emergency Council, *Report on the Economic Conditions of the South*, pamphlet, (June, 1938), pp. 1-2.

[19] C. Vann Woodward, *Origins of the New South, 1877-1913* (Baton Rouge, 1951), 291-320; Walter Prescott Webb, *Divided We Stand* (New York, 1937), pp. 84-131; Melvin Greenhut and W. Tate Whitman, editors, *Essays in Southern Economic Development*, "Four Decades of Thought on the South's Economic Problems," by Clarence H. Danhof, (Chapel Hill, 1964), 7-68.

But southerners were also responsible for their woes. They had persistently held to the Lost Cause, and too few were willing to diversify or challenge "King Cotton" and its concomitant ills. Not until World War II did the South begin its march toward industrialization. The liberating effect of the war lasted, and Texans, like most southerners, were anxious to industrialize and end the tradition of poverty and defeat. This desire for modernization was a motivating factor in the push for flood control and installation of military bases in Texas and partly explained the enthusiasm of the state's inhabitants for the Corps of Engineers. Throughout the state the conviction grew that a comprehensive system of reservoir and river development was necessary not only to resolve the perennial ravages of nature but also the colonial and "backward" status of the economy. "Everywhere men and women began to look closely at their own communities," reported the President's Water Resources Policy Commission in 1950, "and laid special emphasis . . . on the potential values of water development and river control when related to land and industrial use."[20]

Ideology for massive flood control and water development already existed. For over a hundred years the United States had altered the environment for human habitation and enjoyment. The search for solutions had only involved the engineering and technical methods whereby man exerted his control over nature; the search did not include any question of man's wisdom to expand, to industrialize, and to use the resources. The debate over construction of reservoirs for flood control and hydroelectric power had ended more or less with the fight over Muscle Shoals and the Tennessee Valley Authority. Opposition to federal electric development had continued after World War II, but only a few questioned reservoir construction. By providing abundant water, large reservoirs also promoted national defense, a popular argument in the post-war era. By the half-century mark, therefore, conservation had moved from the 1900 concept of protecting wildlife and forests to a broad definition including water for industry, irrigation, hydroelectric power, and soil improvement. Conservation had taken myriad forms. When growing population and increasing industrialization were coupled with this definition

[20] President's Water Resources Policy Commission, *A Water Policy for the American People*, I (Washington, D. C., 1950), 20.

of conservation, a long list of unfinished "conservation jobs" remained, and Texas was only beginning to develop her resources.[21]

But a few conservationists argued against reservoir construction and river improvement. When the FWD was created in 1950, the case against large-scale daming of rivers for the sake of impounding water was already established. Probably the best-known critic was Elmer T. Peterson, associate editor of the *Daily Oklahoma-Oklahoma City Times* and contributor to popular magazines. The Corps of Engineers received the brunt of his charges since it was principally responsible for the feasibility studies of each project as well as construction.

Too often the Corps wanted to build "big dams," Peterson insisted, when smaller structures located further upstream and on feeding tributaries would be better. Large reservoirs also filled with silt, reducing their lifespan to about fifty years. Silt also settled in the upstream channel according to the critics and forced the chastened river to reroute and thereby destroy farmland. By locating small dams on tributaries soil erosion would be reduced more efficiently. And costs did not always warrant construction of the giant dams.[22]

The most discussed difference over flood control was upstream flooding and soil conservation. The "big dam mentality," according to the critics, ignored the importance of an interrelated system of terracing, building grassways to filter the soil from the runoff, and the construction of small dams and checks on creeks and tributaries feeding the major river. Since the primary damage to soil occurred in the upstream watershed, location of a giant dam fifty to one hundred miles downstream, solved only half the problem. Valuable silt washed from the fields and would drift into the reservoir and shorten its lifespan. At a public hearing in 1945 concerning improvements on the Leon River in central Texas, the Coryell county delegation took this position, and although they agreed impoundment would be beneficial, they urged that an integrated plan of conservation be arranged with the Soil Conservation Service. "The spending of millions of

[21] Stephen Raushenbush, "Conservation in 1952," *Annals of the American Academy of Political and Social Science*, CCLXXXI (May, 1952), 6; Robert O. Beatty, "The Conservation Movement," ibid, p. 17; *Military Engineer*, LI (March-April 1959), 20.

[22] Elmer T. Peterson, "Big Dam Foolishness," *Reader's Digest* (July, 1952), 63-66.

dollars for the construction of a major dam without an immediate and intensive upstream program to protect the investment," the delegation concluded, "is not sound economy."[23]

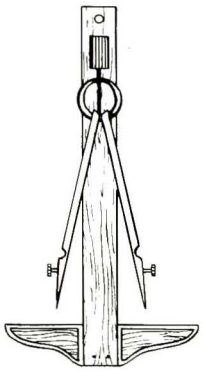
For the people of Texas the old problem of drought and flood overruled the reservations about ecology and soil conservation. Many farmers saw reservoirs as a solution to soil erosion and to the loss of homes and farms; others saw dams as contributors to growth and industrialization. By 1949 enormous demands were made on existing water supplies for consumer and industrial use. Population growth had already required the larger Texas cities to resort to use of surface water (reservoir) and further growth was expected. Only small towns, usually with a population of 5,000 or less, depended on ground water (wells), and that source was becoming less sufficient each day. Floods also prevented growth. They placed flood plain areas "off-limits" to development and in addition to the damage to property and public utilities, they constituted a serious threat to health. During floods sanitary sewers became pressure lines and blew manhole covers, releasing raw sewage into streets. Sewage treatment plants were sometimes washed out and drinking water interrupted. Threat of deadly diseases as typhoid and cholera was real. "The more complex the civilization, and denser the population, the greater the devastation becomes," one observer wrote.[24]

With the philosophical differences resolved, the next step was action. Snake charmers, "scientific" rainmakers, and prayers had never solved the problem of flood and drought. Another group of men worked amid the superstitions, folklore and hucksters. "They are the engineers," wrote a Texas resident, "who plan to make [water] available to people at a rate they can pay."[25]

[23] "Brief Presented by Coryell County," *Improving the Leon River in Interest of Flood Control and Allied Progress*, Public Hearing (November 19, 1945, Belton, Texas), Box 2135, FWD Storage; *Science News Letter* (March 27, 1948), 200.

[24] Quote in Webb, "Billion-Dollar Cure," *Harper's*, p. 75; Fort Worth District Corps of Engineers, "Flood Plain Information, Marine Creek, Fort Worth, Texas," pamphlet (September, 1974), p. 19; R. W. Sundstrom, W. L. Broadhurst, and B. C. Duryer, "Public Water Supplies in Central and North Central Texas," pamphlet, Geological Survey Water Supply Paper 1069 (Washington, D. C., 1949), pp. 2-3.

[25] Webb, "Billion-Dollar Cure," *Harper's*, p. 75.



CHAPTER II

Origin of the Fort Worth District

Throughout the history of the United States, the Army Corps of Engineers has been involved in construction projects, but until the twentieth century it focused primarily on navigation and harbor improvements, plus military construction. Construction of the Panama Canal was probably the Corps' best known achievement. Expansion of the Corps into the area of flood control came when Congress passed the Flood Control Act of 1936, which gave the organization the responsibility for prevention of flooding nationwide. It was only logical for Congress to direct the Corps to address itself to the perennial flooding in Texas, which persisted after World War II. At that time the upper Trinity and Brazos River basins constituted the most serious threat. In order to tame these rivers and other unconquered streams, the Corps of Engineers created the FWD in April, 1950.

As far back as 1880 the Corps of Engineers took an interest in Texas when the Galveston District was established upon the abolition of the old Gulf of Mexico Division. The principal concern of the District was harbor improvement, channelization for navigation, seawall construction, and the Gulf Intracoastal Waterway, a 421 mile waterway stretching from Orange to Brownsville. This emphasis on harbors and canals was evident in the orders issued to Major S. M. Mansfield, Galveston's first District Engineer. He was sent to the island city to prepare "a survey for connecting the inland waters along the Gulf of Mexico

by cuts and canals."[1]

With the mandate handed to the Corps in 1936, plus the growing strength of the state of Texas in national political affairs, Congress began authorizing flood control projects in the Lone Star state in the late 1930's and 1940's. In 1945 it authorized several reservoirs in north Texas, all on the upper Trinity or Brazos River: Benbrook, Lewisville (Garza-Little Elm), Lavon, Grapevine and Whitney. The primary purpose for their construction was flood control. Except for the Whitney dam on the Brazos, a concrete structure to be equipped with hydroelectric facilities, these projects were within a fifty mile radius of Fort Worth. Each was to consist of an earthen dam with a concrete spillway. As work on these new structures began, the activity of the Galveston District shifted considerably to north Texas. To accommodate the new circumstances, a sub-office was established at Fort Worth in 1945, but the headquarters remained in Galveston.[2]

The new sub-office was centered in the old "Bomber plant" that later became part of General Dynamics. James A. Cotton was named project engineer. His initial staff was small with K. K. Clark as head of personnel, and Ray Runder was in charge of hydrology with the assistance of Charles Miron; Eva Pelham was secretary. Growth came fast as the Galveston office contracted work on the authorized reservoirs. In 1947 work started on Benbrook, Whitney and Town Bluff ("Dam B") located on the lower Neches River. Construction began on Lavon, Grapevine and Lewisville in 1948. The following year work on the Belton Dam on the Leon River started.[3]

As the steadily increasing workload required more personnel and office space, the sub-office moved to the sixth floor of the Texas and Pacific building on Lancaster Avenue. Administrative and office employees numbered about 100. Despite such growth, however, rumors periodically circulated that the Fort Worth office would be closed and returned to Galveston, owing to a general plan to reduce federal expenditures throughout the United States. At one point as much as 60 percent of the force was

[1] Lynn M. Alperin, *Custodians of the Coast: History of the United States Army Engineers at Galveston* (Galveston, 1977), 41-44.

[2] Chief of Engineers, *Annual Report* (1946), pp. 1093-1195.

[3] Robert Craft "History of the Fort Worth District, U. S. Army Corps of Engineers," (March 4, 1975), typescript, p. 9; Annual Report, p. 1196.

destined for termination, about seventy-five employees. Such plans never materialized because shortage of water persisted in parts of Texas. In 1946 the Fort Worth *Star-Telegram* reported that "lack of water is now the principal drawback to further economic development and population increase."[4]

It was this last thought, the need to develop water resources and provide flood control, that set in motion the chain of events leading to the creation of the FWD. Led by the Trinity Improvement Association, an organization founded in 1930 and dedicated to the channelization of the Trinity River for barge traffic, local interests in the Fort Worth-Dallas area sought to have a full-fledged District established near them, explaining that the Galveston District was fully burdened with coastal improvements. The new north Texas flood control projects constituted an overload for the Galveston District. The nature of the Corps' projects in Texas, furthermore, was not conducive for one office, namely, coastal navigation and reservoir construction. For the sake of efficiency and speed, they continued, a new District was warranted in north Texas. Newspaper publisher Amon Carter of Fort Worth and Dallas business executive John W. Carpenter were chiefly responsible for marshalling the forces together for the new District.[5]

The 1949 flood in Fort Worth added a great sense of urgency to the completion of flood control projects in north Texas. It also gave extra weight to the petition for a new District. Texas Senator Tom Connally, waving photographs of the flood's destruction in Fort Worth on the Senate floor, expressed this urgency when he requested an additional $500,000 to speed completion of the Benbrook reservoir. Central Texas Representative Olin Teague also joined the chorus when he reminded his colleagues "to take prompt action so that the Trinity River flood-control program may be carried out with dispatch . . . ."[6] These pleas drew attention to flooding and the shortage of water in many municipalities in Texas and were representative of the growing conviction that a new District was essential.

[4] Ray Runder to D. Clayton Brown, Interview, June 22, 1977; Fort Worth *Star-Telegram*, June 23, 1946.

[5] "Notes on SWD History," p. 29; Delbert B. Freeman to D. Clayton Brown, Interview, June 3, 1977.

[6] Quote in *Congressional Record*, 81st Congress, 1st Session, Vol. 95, pt. 1, p. 6527; ibid., pt. 12, p. A726.

Meanwhile the Galveston District conducted a feasibility study of a new District. For fiscal year 1950, the Galveston District's appropriations for flood control were four times greater than its appropriations for river and harbor improvements. In combined military and civil construction during the previous year, the Galveston District was the third largest in the Corps. And for 1950, it expected to have one of the largest workloads of the forty-three Districts in the United States. In terms of geographic size, furthermore, the Galveston District was the third largest, and larger than the New England Division, the North Atlantic Division and the Lower Mississippi Division.[7]

According to the study, establishment of a new District at Fort Worth with jurisdiction over flood control projects would not jeopardize the Galveston office, for the latter would remain "a big district." But the proposed District would also be larger either in geographic size or budget. A new office more centrally located within the area of reservoir operations would reduce travel and transportation costs by approximately $20,000 per year. Savings in personnel would be a total of fifty-three graded and thirteen ungraded positions. "The estimated travel factor for Fort Worth," according to the report, "is 20 percent less than that for Galveston."[8]

Housing the proposed District and its employees was not expected to be a problem. The existence of the sub-office in the Texas and Pacific building solved part of the problem, and additional space, though temporary, could be secured according to the study. Employee housing at different price levels appeared adequate because 500 housing units were being completed monthly in Fort Worth. This figure was inflated since it included current and proposed housing statistics in Fort Worth. One company had 275 apartments under construction with plans to rent them at $65 to $133 per month. Rent houses were available at $80 per month, and "any desired number of houses were for sale." Another company had 198 apartments under construction and planned to rent them at $55 each. That same firm hoped to build another 180 units. "The housing situation," the report concluded, "would be a great improvement over that of

[7] "Analysis on Establishment of Fort Worth District," (N.D.) typescript, pp. 1-4, files of Southwestern Division, Corps of Engineers.

[8] Ibid., pp. 6-9; Fort Worth *Star-Telegram*, April 5, 1950.

Galveston."[9] As it turned out, personal housing was no problem, but space for the District office was another matter.

By the spring of 1950 the momentum for a new District to be located in Fort Worth had reached the point of decision. On March 6, 1950, Colonel Lewis W. Prentiss, Division Engineer of the Southwestern Division in Dallas, announced to the public the establishment of the FWD. It would execute flood control and water conservation and utilization functions for the area heretofore handled by the Galveston District. To justify the new District, Colonel Prentiss pointed out that Fort Worth was centrally located to flood control activities of the Corps of Engineers in Texas. Existence of the sub-office at "cowtown" also served to justify the new location.[10]

Official establishment of the FWD came on April 14, 1950, when the Office of the Chief of Engineers issued General Order No. 4. "By authority of the Secretary of the Army and effective 16 April 1950, a new Corps of Engineers District, to be known as the Fort Worth District, is established . . . ." It will "supervise and prosecute all work relating to flood control . . . within the present territorial limits of the Galveston District." Navigation, drainage of coastal areas and military construction remained with the latter office. The Buffalo Bayou flood control project located in Houston also remained under the older District's jurisdiction since it was an integral part of the Houston ship channel. Thus, the FWD, currently one of the largest with a variety of responsibilities, was originally authorized for flood control only.[11]

Opening operations in Fort Worth was no small task. Though employees of the old sub-office were the nucleus of the new District, comprising one-fourth of the total, a large contingent of furniture and equipment had to be moved from Galveston. Approximately 125 families were also transferred. Careful plans had started a month earlier when a detailed schedule for each Division was arranged, including procedures to handle

[9] "Analysis on Fort Worth District," p. 6.

[10] News Release, March 6, 1950, SWD files. The Denison Chamber of Commerce tried to get the new District located at Denison, arguing that the existence of the Denison District (1939-1944) was sufficient precedent to justify location of the new District there. See Paul D. Marable to Sam Rayburn, March 18, 1950, Sam Rayburn Papers, Rayburn Library.

[11] General Order No. 4, April 14, 1950, Compilation of General Orders, Office of Chief of Engineers, FWD Library.

employees' fiscal matters and advertising for bids to award contracts to moving van companies. Even allotment of space and floor plans of the new office were specified in Galveston. This planning proved quite beneficial because the move progressed smoothly and according to the timetable. Years later employees recalled no difficulty or losses in the transfer.[12]

Only one mishap occurred and it was tragic. Gil Fields of the Engineering Division was part of the special task force expediting the move. Described as a personable and capable planning engineer, he and his wife were among the last to leave for north Texas. On the outskirts of Galveston, they were killed in a "head-on" crash when a pick-up truck negligently turned onto the highway. The news stunned the new District, and his death required some reorganization of the task force.[13]

Personnel and furniture vans began arriving in Fort Worth on Friday, April 14. Some trucks pulled up to the Texas and Pacific building, the headquarters site, at 3:00 A. M. and were met by Don Denney of the task force. Vans steadily drifted into town and unloaded. That week-end witnessed a massive search for housing, for living accommodations were not as readily available as anticipated. Quarters could generally be found, though some remembered that housing was scarce. The city Chamber of Commerce helped. Some employees stayed with relatives or friends until housing was located. Business firms such as department stores and bakeries formed a "welcome wagon."[14]

One real problem, however, had developed. Quarters of the new District were scattered over the downtown area in buildings not originally constructed as offices. Executive offices and part of the Engineering, Construction and Personnel Divisions occupied the eleventh and twelfth floors of the Texas and Pacific building. It was not air-conditioned, and during that first summer everyone raised windows for relief, but the gusty Texas wind forced them to keep all papers weighted. Temperatures became unbearable, reaching over 100 degrees frequently. So hot was the building that

[12] "Public Affairs History Notebook," (N.D.), FWD PAO; Memorandum, Establishing the Fort Worth District Office, March 16, 1950, District Engineer Galveston, SWD files. One employee, Ted Kirchem, remembered that movers' trucks sometimes broke down and desks would not be in the office when they were scheduled to arrive. See Minutes, Historical Committee, March 2, 1973, Box 804, FWD Storage.

[13] Lovena Deimel to D. Clayton Brown, May 5, 1977; PAO, "History Notebook."

[14] Ibid.

Lovena Deimel demonstrates the easy way to hunt a home after transfer with her husband, Ludwig M. Deimel, from Galveston. She sits on a shipping crate to telephone while waiting for the office furniture to arrive. (Courtesy of Fort Worth *Star-Telegram*)

a special summer schedule was arranged. Everyone left at 11:00 A.M. and returned at 4:00 P.M. to finish the day.[15]

Other office areas included the old Hobbs Trailer Company manufacturing building, a one-story structure resembling a gigantic dance floor. Spots were quickly marked on the concrete for desks, and partitions were erected. The Ben E. Keith Company, a vegetable produce firm, offered its warehouse on South Jones Street where the Reproduction Branch was located. At 401 North Main, the Texas Electric Service Company "barn," the following offices were housed: Real Estate, Reports and Planning, Fiscal, Operations and Property. None of the buildings were originally designed as office space. In some cases heating in the winter was inadequate, forcing many employees to wear outdoor coats and hats at their desk. It was obvious, as one reporter wrote, "the city was unprepared for the Corps."[16]

However difficult the circumstances, the FWD went into operation quickly and smoothly. Centrally located within its area of operations and enthusiastically supported by the north Texas people it served, the District at full strength had 584 employees charged with a single responsibility—to remove the threat of flooding in the Lone Star state. On June 16, one month after the move, the District celebrated the 175th birthday of the Corps of Engineers, and newspapers, local political leaders and other voices of the public took the opportunity to welcome the Corps to Fort Worth. The District was ready to go to work.[17]

Leading the District at this critical point was Lieutenant Colonel Delbert B. Freeman. Widely known among his friends as "Del," he was an affable and easy-going person who communicated both strength and gentleness. He was popular with his employees and the public. It was partly for his charm and familiarity with Texans that Major General Lewis A. Pick selected the Colonel for the job. Born and raised in Las Cruces, New Mexico, only forty-five miles from El Paso, Texas, Freeman was a product of the dry West and understood drought and the importance of water.

[15] Ibid.; Lt. Colonel Lyle to D. Clayton Brown, June 6, 1977.

[16] L. Deimel to C. Brown; Craft, "History of the FWD," p. 17; Fort Worth *Star-Telegram*, April 17, 1950.

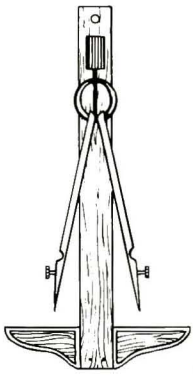
[17] Ibid.; June 16, 1950; San Angelo *Standard-Times*, June 11, 1950; Official Memorandum by Governor Allan Shivers, May 29, 1950, Box 141, FWD Storage; *The Orange Leader* (Orange, Texas), June 11, 1950.

His professional experience also gave him valuable background for this particular assignment. After taking a degree in civil engineering at New Mexico A&M University in 1925, Freeman was engaged in irrigation and drainage work as a civilian in California. In 1928 he accepted employment with the Corps in Kansas City, Missouri, as a civilian engineer. He assisted in the design of the large Fort Peck Dam in Montana and assisted in flood control projects throughout the Missouri River basin. In 1942 he was commissioned in the Corps of Engineers and was General Pick's Executive Officer at Omaha. As Pick's Executive he participated in the preparation of the "Pick Plan," the large-scale improvement program for the Missouri River basin. For a short time he was the District Engineer at Omaha. In 1947 Colonel Freeman was assigned to Japan and served on General Douglas MacArthur's staff in Tokyo. His professional life had, therefore, been in the field and not the classroom. By experience and circumstance he was a man of action well equipped for the massive flood control program already underway in Texas, and he was experienced in working with powerful and influential people.[18]

As soon as he had reported to Fort Worth on April 4, 1950, he quickly rushed to Galveston in order to bring himself up-to-date on Texas' water projects. He did not wait to find a house in Fort Worth, but trusted his wife Edith to select one. Along his return trip, he surveyed construction sites by plane, and two weeks after the new District was officially formed, he reassured the citizens of Fort Worth that the Corps would "hurry to speed up the city's flood protection program."[19]

Fast and efficient, "Del" was the perfect choice to set the FWD on its course. Brought into existence by the crushing need of flood control so well illustrated by the death of two year old Renee St. John and ten others drowned in the 1949 Fort Worth floodwaters, the new District began with a sense of urgency. Benbrook Dam and the Fort Worth Floodway were not finished, and though it was unknown in 1950, Texas was on the verge of entering one of the worst droughts in its history. Completion of the reservoirs was imperative.

[18] D. Freeman to C. Brown; Biographical Notes, Box 141, FWD Storage.
[19] Fort Worth *Star-Telegram*, April 7, April 25, 1950.



CHAPTER III

Civil and Military Construction: From Reservoirs to ICBM's

During the 1950's growth and expansion characterized the FWD. Not only was it charged with the responsibility to finish the civil projects inherited from the Galveston District, but the FWD conducted planning studies of new projects. When the Korean conflict broke out in 1950, it received responsibility for military construction. Jurisdiction for civilian and military projects extended both the geographic and operational size of the District, making it one of the largest in the United States. The number of employees exceeded 600, a significantly larger number than that in any other District in the Southwestern Division. Throughout the decade drought and flood hit Texas, and the contribution of the FWD in combatting both firmly established its role in the economic development of the state.

When the new District went into operation in 1950, a large amount of work was, of course, already underway in the Upper Trinity Basin. Local interests in north central Texas had pointed to those particular projects to justify creation of the District. The Fort Worth-Dallas political interests involved in the creation of the FWD had sought the help of the Corps of Engineers for two purposes: to establish control over flooding in the Trinity River and to develop the river for navigation from Fort Worth to the Gulf of Mexico. Though one was complimentary to the other, flood control was the primary reason for building four reservoirs on the Upper Trinity: Benbrook, Grapevine, Lavon and Lewisville. At the same time the FWD constructed floodway

projects in Fort Worth and Dallas to contain the Trinity which passed through the heart of both cities. In the upper portion of the state, therefore, flood control was the real objective of the District.

On the Brazos River, however, the situation was different. In 1941 Congress had authorized Whitney Dam, a multi-purpose project that would provide flood control and generate electric power. Political interests behind the Whitney structure had a rural constituency whose living conditions were different from those of their city cousins in Fort Worth and Dallas. During the late 1920's when the drive for the reservoir on the Brazos started, less than 10 percent of the farms in Texas had electricity. Rural families still lived without running water, indoor bathrooms, incandescent lighting and the variety of appliances and conveniences available in the city. Thanks to the Rural Electrification Administration (REA) program that started in 1935, Texas farms began to receive electricity, but shortages of power persisted. During World War II shortages worsened in the rural areas because defense plants had top priority for energy. It was for this reason, to overcome the shortage of power, that the local interests at Whitney saw the Brazos as a source of energy, a means by which they could modernize their homes and farms and enjoy a standard of living commensurate with an industrial society.[1]

Design plans at Whitney included, therefore, a powerhouse having two turbines, each with a capacity of 20,700 horsepower, and two 15,000 kw generators. The dam was expected to produce 85,000,000 kilowatt-hours per year. Energy would be fed directly to the rural electric cooperatives in the central Texas area.[2]

Hydroelectric facilities had not been put in the structures on the Upper Trinity, plus Town Bluff Dam, Belton Dam and the O. C. Fisher (San Angelo) Dam because the amount of impounded water would be too small to provide a dependable flow for power generation. In the case of Lavon, for example, the Federal Power Commission (FPC) reported "that a power plant with an installation of about 1,000 kilowatts capable of

[1] D. Clayton Brown, "Sam Rayburn and the Development of Public Power in the Southwest," *Southwestern Historical Quarterly*, LXXIII (October, 1974), 140-141.

[2] Fort Worth *Press*, December 28, 1951; Dale Powell to D. Clayton Brown, Interview, June 23, 1977.

producing an average annual output of 5,000,000 kilowatt-hours would be possible of development. However, the studies indicate that the development of this power would not be economically feasible."[3] In other words, power plants were technically possible, but generation of power was not economically justified. According to the FPC, inclusion of penstocks for future power generation was also not warranted.

Lavon was too small for power generation, but Lewisville and Grapevine were large enough to supply a dependable flow of water. But in each case the FPC estimated that only a 2,500 kilowatt installation was possible, and according to 1948 costs, installation of each unit would cost $800,000 and have a corresponding annual cost of $49,000. Assuming that the flow releases from the conservation storage could be regulated during a dry period to serve the purposes of power development and assuming a dependable capacity of 1,500 kilowatts, the annual benefits would be $38,000 based on power values of $19.40 per kilowatt per year for capacity and 1.33 mills per kilowatt-hour for energy. "In view of the indicated benefit-ratio of about 0.8," the FPC concluded, "the development of power would not be economically justified."[4] These conclusions were based on a steady stream of water throughout the dry seasons—or years. They were also based on the price of natural gas at twenty cents per thousand cubic feet which made steam generation as cheap as hydro.[5]

The differences in the purpose of the dams demonstrated the diversity of needs in Texas for economic development. Urban constituencies along the banks of the Trinity River wanted protection from floods, but they also wanted to develop the river for eventual navigation of manufactural and industrial products. Farmers and small town residents in the Whitney environs wanted to modernize their homes and farms with appliances and machinery and desperately needed additional sources of electrical energy. As an instrument of public policy, the FWD had to furnish the skills and management necessary for both to achieve their goal.

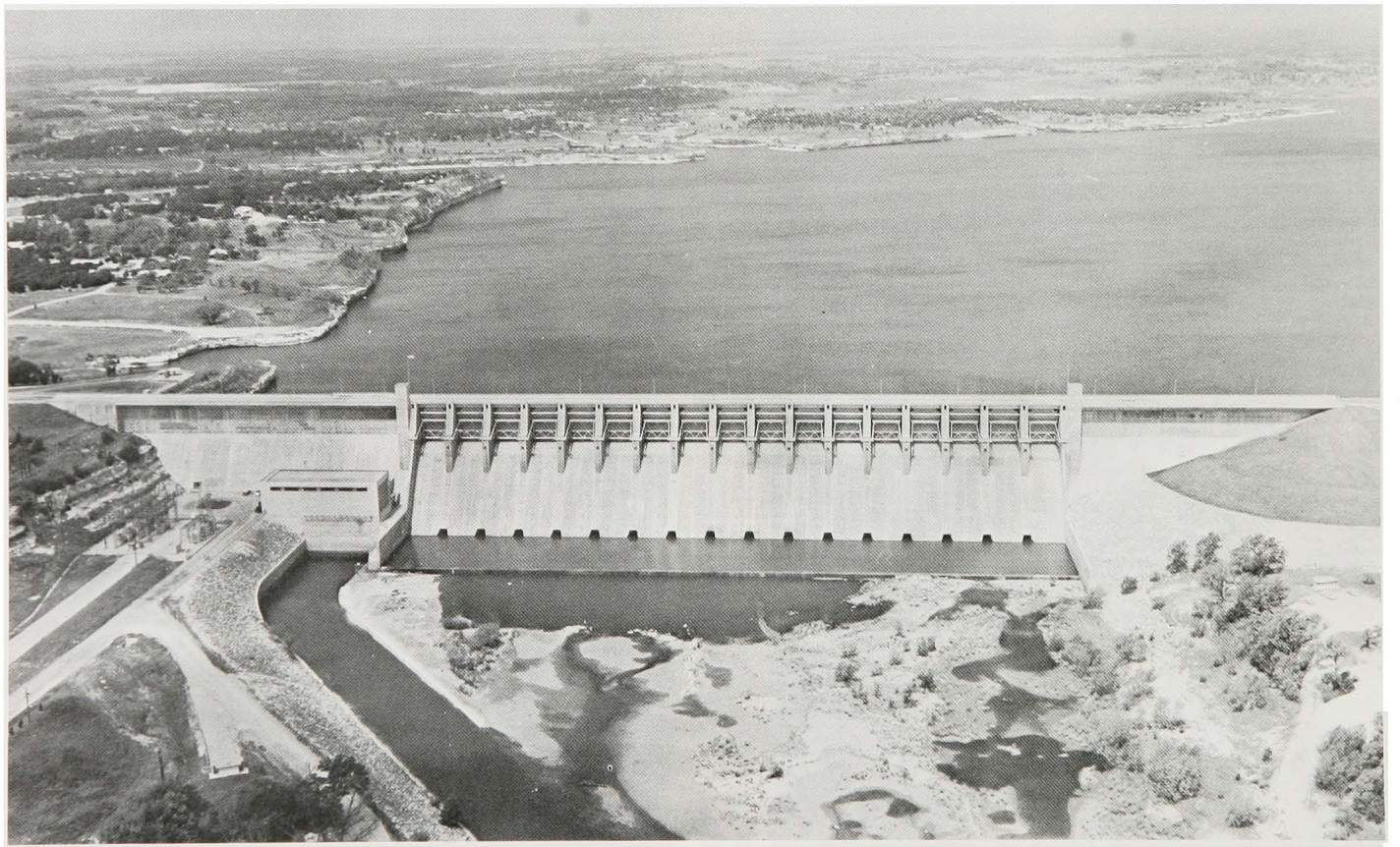
[3] Nelson Lee Smith to Kenneth C. Royall, Secretary of the Army, June 25, 1948, SWD files.

[4] Ibid.

[5] D. Powell to C. Brown.

Kerosene lantern and fireplace used to light a home without electricity. (Courtesy of Tennessee Valley Authority)

Life on a farm without electricity. (Courtesy of Tennessee Valley Authority)



Whitney Dam on the Brazos River.

Construction on each of the reservoir projects was already underway when the FWD was started in 1950. By 1955 the last reservoir project on the Upper Trinity was complete. Total cost of the four dams was $53,800,000, and total annual benefits measured in flood control was $7,896,100. Through the North Texas Municipal Water District, ten communities drew water from Lavon, a timely benefit since the ground supplies of water were dwindling. Although recreation was not in the original plans, it quickly became a by-product of the projects as evident in the extensive boating, fishing, camping and lodging facilities at each lake. Housing developments on private property sprang up around the reservoirs. Nearby small towns had an economic upswing. Recreational benefits cannot be measured in monetary terms, but the spurt to the local economies was gigantic. While the four Trinity River reservoirs were built for flood control, Benbrook and Grapevine were also built as navigation projects.[6]

In terms of benefits for the average citizen, Whitney Dam was the most "profitable" because it also generated electricity. A large structure, the first concrete dam built by the FWD, it was 17,695 feet in length including the earthen section. The concrete section was 1,674 feet long. One hundred fifty-nine feet at the highest point, the spillway section had seventeen tainter gates, each 40 x 38 feet. Sixteen conduits, 5 x 9 feet, carried the discharge through the dam. Two penstocks guided the flow of water to the two 15,000 kw generators. Completion of the dam came in 1951, and it became operational for flood control and water conservation. The power facilities went into commercial operation four years later. With a storage capacity of 2,017,500 acre-feet and an additional 255,300 acre-feet for sedimentation reserve, Whitney was the largest lake in Texas.[7]

The Southwestern Power Administration (SPA) of the Department of the Interior marketed the power generated at Whitney. It sold the electricity to the Brazos River Transmission Cooperative, a generating and transmission (G&T) co-op which resold the energy to nineteen distribution rural electric

[6] Herbert D. Vogel to C. H. Chorpening, August 10, 1952, "In Person Files," Box 72, FWD Storage; *Water Resources Development by the Corps of Engineers in Texas*, pamphlet, (January, 1957), pp. 17-20.

[7] Lake Texoma was larger, but it was the boundary between Texas and Oklahoma and was not wholly a Texas lake. Ibid.; Fort Worth *Star-Telegram*, March 5, 1951; Dallas *Morning News*, January 5, 1951.

cooperatives. Wholesale rates of the power went to the G&T co-op at 0.4 mills per kilowatt-hour, enabling the customer at the end of the line to receive a competitive charge for his electricity. Rates were calculated to return to the government over a fifty year period the cost of the power facilities, plus interest at 2½ percent. Volume of power generated varied from year to year, depending on rainfall and the amount of water in the reservoir. With the power pool at its lowest level, the dam would produce 23,000 kilowatts, but at maximum the structure would generate 30,000 kilowatts.[8]

The remaining reservoir projects, Town Bluff, O. C. Fisher Dam and Belton Dam, were also finished in the early 1950's. These were earthen structures designed for flood control and water supply. Town Bluff in the Neches-Angelina River Basin was originally intended to regulate the surge of water released from Sam Rayburn Dam (McGee Bend), another hydroelectric structure to be built about 37 miles upstream on the Angelina River. The latter was not started until 1956.

For control of floods on the Trinity River, reservoirs were not the only recourse available. Levees were erected alongside the stream's banks, and the main channel was deepened. This technique, known as a floodway, offered maximum protection from a rampaging river when used with reservoirs. In 1950 the FWD was assigned the responsibility to repair the Fort Worth levees damaged, and it was instructed to repair and improve those in Dallas. With the dams at Benbrook, Lewisville and Grapevine, the levees would virtually guarantee protection from the Trinity River.

The city of Fort Worth had built levees alongside the Clear Fork and West Fork of the Trinity in 1928, but for lack of maintenance they broke at several points in 1949 and let the floodwaters escape into the city. In 1945 Congress had authorized a project to repair them, but work had not started for lack of appropriations. After the disastrous Fort Worth flood in 1949, Congress quickly appropriated $500,000 for work to begin. In

[8] William Helpert to D. Clayton Brown, Telephone, June 30, 1977; Fort Worth *Press*, December 28, 1951. For a larger discussion of the role of the Southwestern Power Administration, see Brown, "Sam Rayburn and the Development of Public Power in the Southwest," *Southwestern Historical Quarterly*.

June, 1950, full-scale construction began.[9]

Brush, trees and garbage had accumulated along the channel of the Trinity River in Fort Worth. Draglines proceeded to dig a gently curving channel with sloping banks and a wide, smooth floor. Kinks and bends, "bottlenecks" at floodstage, were removed. By eliminating the latter, the river was one mile shorter. Removal of 7,000,000 cubic yards of earth, almost as much as that removed for the Benbrook Reservoir, was required. The old levees were made wider, not higher. At some points they were lowered, but with a deeper channel the danger of overflow was, nonetheless, reduced. At the Texas Electric Service Company generating plant on North Main a small dam was replaced.[10]

Several bridges had to be replaced or lengthened. The West Seventh Street viaduct was extended 530 feet on its west end, and the channel modified at that crossing to force the stream flow directly beneath that section of the viaduct that was solid embankment. Three bridges were replaced with spans that not only promoted flood protection but also a freer flow of traffic. Thus, a by-product of the floodway was an improvement in city traffic.[11]

Construction had progressed according to schedule when in September, 1954, opposition quickly erupted. A group of housewives placed themselves in front of bulldozers pushing down shade trees along Rockwood Drive. They wanted to protect several large trees shading their homes and thought the levee should be moved far enough away so as not to bother the trees. At one point several women dramatically linked hands around a tree to stop work. Not all the residents in the area agreed with them because one man's home had been covered with floodwater in 1949. "I've had to run from four floods," he told reporters, "and I'm tired of it."[12] After meeting with the homeowners and the Tarrant County Water Improvement District, the FWD agreed to leave some trees, though "that was not ordinarily done," said Lieutenant Colonel W. G. Trainer, "because it's not good hydraulics."[13]

[9] News Release, Corps of Engineers, Galveston District, January 18, 1950, SWD files; Fort Worth *Star-Telegram*, June 29, 1949.

[10] *Texas Contractor* (May 4, 1954); Fort Worth *Press*, June 20, 1950.

[11] Ibid.

[12] Fort Worth *Star-Telegram*, September 10, 1954.

[13] Ibid.; R. Runder to C. Brown.

For construction of floodways, local interests had to share the costs. Fort Worth contributed $5,346,000, and federal expenditures amounted to $3,865,000 for a total cost of $9,211,000. When it was completed in 1954, the floodway was placed under the jurisdiction of the Tarrant County Flood Control and Water Improvement District No. 1.[14]

If the restoration of levees encountered few obstacles in Fort Worth, it was a different story in Dallas. A similar situation existed in the latter where the Trinity also wound alongside downtown. In 1928 Dallas had erected levees along the river, but time had slowly eroded the structures and the population spread in such a manner that a more comprehensive and up-to-date levee and channelization project was needed. Congress authorized a floodway in 1945, but provided no funding.[15]

For eight years "Big-D" had to wait on a fiscally conservative Congress; a cost-conscious Budget Bureau would not fund the project. The outbreak of the Korean conflict in 1950 had added to the burden of the federal Treasury. In 1952 a special delegation consisting of John Fouts, Dallas Chamber of Commerce general manager, and several associates visited President Harry S. Truman. The President agreed to help. In a short time Congress funded the Dallas Floodway, and the FWD had another project to build.[16]

The project called for twenty-three miles of levee improvement and a deeper channel. A large pressure sewer had to be placed on Turtle Creek and a fifty-six foot gated control tower near the end of the creek. The Dallas County Flood Control District contributed $300,000 toward construction of the sewer. As was the case in Fort Worth, local interests furnished right-of-ways and easements and assumed responsibility for maintenance and operation of the system when it was finished in 1959. Ten thousand acres of bottomland became available for industrial use after the threat of flood was removed.[17]

Besides completing those projects already underway in 1950, the FWD also conducted planning studies and made investigation

[14] D. Freeman to C. Brown; *Texas Contractor* (May 4, 1954).

[15] Dallas *Times-Herald*, October 21, 1951; Dallas *Morning News*, December 9, 1928, February 18, 1951, February 21, 1952.

[16] Ibid.; Dallas *Times-Herald*, April 18, 1952.

[17] Dallas *Morning News*, June 4, 1959; Corps of Engineers News Release, May 13, 1954, Box 141, FWD Storage.

Housewives stop bulldozers on the Fort Worth Floodway, September 1954. (Courtesy of the Fort Worth *Star-Telegram)*

Flooding in Fort Worth, April, 1957.

Victims of the Texas drought at midsummer, 1955. (Courtesy of U.S. Soil Conservation Service)

Severe wind erosion from drought in Dawson County, Texas. (Courtesy of U.S. Soil Conservation Service)

reports for future projects. In some cases these studies were later used to build new reservoirs such as the Waco Dam. The Dallas Floodway had also been in the "planning stage" for three years until Congress appropriated funds to begin construction in 1953. The same was true of Sam Rayburn Dam on the Neches-Angelina River until construction started in 1956. Smaller projects such as Mills Creek were also examined for flood prevention. Thus, the District simultaneously planned for future tasks as well as constructed those projects already approved. Feasibility studies of a project, however, did not guarantee that it would be built. Congress refused to fund Dam "A" and Rockland Dam, both in the Neches-Angelina River basin. An important part of the workload, therefore, included studies of potential flood control sites.[18]

Throughout this period of intense activity, Texas went through another drought. During the period 1950-1956, the state experienced its longest severe dry period on record. According to some reports, it was the driest spell in 300 years. The wettest five consecutive years were ironically during 1945-1949, amply demonstrating the sharp contrast in Texas weather. So scarce was rain that several of the reservoirs could not fill with water. In 1956, the driest year, farm income dropped $500,000,000 from the previous year which was also low because of the drought. Many farmers and ranchers sold their land and took factory jobs. Forty-six Texas counties distributed federal relief food to families. Even drought-resistent live oak trees died. President Dwight D. Eisenhower declared the area a national disaster, and after personally inspecting the state in early 1957, he increased federal relief.[19]

The drought demonstrated the benefits of river impoundment. Town Bluff Dam supplied water to rice growers on the lower Neches River Basin, and the FWD released enough water from Whitney in 1952 to save a $5,000,000 rice crop on the lower Brazos River. On the Trinity reservoirs, a total of 672,000 acre-feet of water had been impounded and put under contract to supply

[18] *Hearings Before the Subcommittee of the Committee on Appropriations*, House of Representatives, 84th Congress, 1st Session, pt. 2, pp. 450-465; Minutes, Historical Committee, April 6, 1973, FWD.

[19] *Saturday Evening Post* (December 1, 1956); *U. S. News and World Report* (January 11, 1953), 11; Dallas *Morning News*, April 9, 1958.

water to Fort Worth, Dallas and the surrounding municipalities. At the Belton Reservoir in October, 1956, enough water was released to supply the Dow Chemical plant which had only a 10 day supply of water left.[20]

Just as earlier droughts had convinced Texans that reservoir construction was necessary, the drought of the 1950's reaffirmed their conviction to keep building dams in order to "save every last drop." The relief afforded by those reservoirs just completed illustrated in strong terms that the impoundment of rivers was justified. In 1957, however, the weather abruptly changed; the "westerlies," the prevailing winds of the upper atmosphere, shifted farther south, bringing heavy rains. That year Texas experienced severe flooding, and again the Corps of Engineers reservoirs demonstrated their value.[21]

The rains of 1957, the worst of the century in some areas of Texas, thoroughly tested the flood control projects in progress for the past ten years. On the Upper Trinity the combined reservoirs and the two floodways kept homes and businesses safe. As water flowed safely through Fort Worth and Dallas, it was called the "great flood that didn't happen." An estimated $84,000,000 in flood damage was prevented in the Upper Trinity Basin alone. Over 600 businesses and industrial establishments and 7,000 homes escaped flooding. Some minor damage occurred in portions of the Dallas Floodway where construction was not finished. So great were the rains that year that the discharge was 1½ times greater than that of the 1908 flood. Without the flood control projects, District engineers estimated that water would have reached the Adolphus Hotel in downtown Dallas.[22]

Throughout the state where FWD projects were complete, the same benefits were evident. Eight separate floods had roared down the Brazos, but were stopped and tamed by the Whitney Dam. "There wouldn't have been much Waco today," reported

[20] Herbert Vogel Before Texas Water Resources Committee, April 15, 1954, Speech Notebook, Executive Office, FWD; "Civil Works in Drought Area-Report to President's Coordinator for Public Works Planning," typescript, (March 15, 1957), pp. 15-17, SWD files; Memorandum, Contributions to Natural Disaster Operations (N.D.), Box 151, FWD Storage.

[21] Harry O. Fischer Before Jasper Chamber of Commerce, January 27, 1956, Speech Notebook, Executive Office, FWD; Dallas *Morning News*, June 23, 1957.

[22] Remarks of General William Whipple, Southwestern Division Engineer, June 8, 1959, SWD files.

one official of the city located downstream, "if it hadn't been for Whitney."[23] Even the largest lake in Texas, however, had trouble containing the worst deluge since the turn of the century. The level of the lake rose to the top of the flood pool and concessions along the banks were damaged. Some floated and were unharmed, but others were submerged in the murky water and pounded into splinters by currents and waves. Access roads were covered and a log jam threatened a $1,000,000 bridge on Highway 174, but work crews, after a month-long battle, removed the debris and saved the bridge. Without the reservoir, flooding along the Brazos would obviously have been disastrous.

Successful management accounted for the smooth operations in the field, a tribute to Colonel Freeman's administrative efforts. During its first few months of operation, the FWD faced a problem of efficiency, meaning that the speed of work did not operate at maximum. Part of the difficulty was inherent with any new District settling into a routine. The staff, however, had been pulled from several Districts in 1950: Galveston, Tulsa, Little Rock and the discontinued Denison District. Personnel from the old sub-office in Fort Worth were the foundation staff.

The staff identified and grouped together by their previous Districts. To combat this situation, Colonel Freeman created an unofficial management branch under the direction of Lieutenant Colonel Clayton Lyle. Consisting only of a secretary and one assistant, the new "branch" sought ways to expedite operations. In a short time Colonel Lyle had pulled the staff together and the employees identified with the new District. An example of this efficiency was the reply to the commander of the Fourth Army at Fort Sam Houston who asked if the Belton Reservoir could be finished a year ahead of schedule. Colonel Freeman quickly supplied General Louis Prentiss, Southwestern Division Engineer, with the results of a study made three months earlier for that same purpose, and it showed that technical and financial considerations prevented any change in the schedule. This prompt reply was indicative of the efficiency of the District.[24]

Freeman's initiative was rewarded again when the Korean conflict broke out. Throughout the United States the workload of

[23] Fort Worth *Press*, June 18, 1957.

[24] C. Lyle to C. Brown; Louis Prentiss to Delbert Freeman, April 25, 1951, May 17, 1951, "In Person Files," Box 72, FWD Storage; Freeman to Prentiss, May 1, 1951, ibid.

the Corps of Engineers increased dramatically, and the Southwestern Division Engineer decided that each District under his command should have a formal Management Branch. When General Prentiss informed Freeman of this decision, the FWD was ready to move. A qualified civilian employee, Jack D. Butler, was found, and the new Branch simply inherited the functions of Colonel Lyle's special team.

In another respect Colonel Freeman set the new District on an excellent course. His wife, Edith, was a cousin of the president of the West Texas Chamber of Commerce, Berl Godfrey, an attorney in Fort Worth. The Colonel was able to establish a friendlier relationship with the Fort Worth and Dallas civic leaders than would probably have otherwise been the case. This contact point, plus Freeman's congenial personality, were advantageous to the new District, for he established a friendly atmosphere that encouraged cooperation. One Division Engineer, Colonel Herbert D. Vogel, told Brigadier General C. H. Chorpening in the Chief of Engineer's Office that he was impressed with the excellent public relations the FWD had established in Texas.[25]

By 1952 a sense of order and unity of administrative procedures were evident, a point marked that year by the move into the new Leonard Building at 100 West Vickery Street. Since 1950 the staff had been scattered in train depots, bus terminals and even a vegetable warehouse. By centrally locating in one building the daily routine was simplified and the unity of the District headquarters was more apparent. Best of all, the new structure was air-conditioned. No longer did employees keep thermometers on their desk to record the peak temperatures of the day, which frequently had reached 100 degrees in the old quarters. Till this day employees recall the relief they felt when they escaped the searing heat of the Texas summer.[26]

In June 1950, when the Korean conflict broke out, the FWD underwent major changes. The North Korean invasion of South Korea was unexpected in the United States, and when President Truman sent American troops into the conflict the armed forces were unprepared. Suddenly the country had a new emergency—to defeat the communist forces attempting to conquer South Korea.

[25] D. Freeman to C. Brown; Herbert D. Vogel to C. H. Chorpening, August 14, 1952, "In Person Files," Box 72, FWD Storage.

[26] Craft, "History of the FWD," p. 18; L. Deimel to C. Brown.

Amon Carter, left, welcomes General Douglas MacArthur to Fort Worth. Colonel Delbert Freeman on right.

Picture of Fort Worth District Office Civilian Employees Receiving 30, 20, and 10 Year Awards on Engineer Day, 16 June 1952

Engineer Day, 1952, at the Vickery Street headquarters.

Congress immediately appropriated funds for a crash military expansion program, and the Corps of Engineers received the responsibility to construct some of the facilities necessary to fight the conflict.

The FWD formally expanded on January 16, 1951, when the Office of Chief of Engineers (OCE) added military mobilization and procurement functions to its responsibilities. In this new task the District was assigned an area consisting of Texas, Oklahoma, Arkansas and Louisiana. The purpose was to mobilize industries in those states which produced military gear and equipment to support the armed forces. Procurement of military material quickly reached large-scale proportions and included items such as boats, earth moving and power generating equipment, prefabricated housing and motor vehicles. Most of the material was shipped to the Korean front. By the end of the conflict in 1953, the cost of this function of the District reached $100,000,000. In 1963 this function was transferred to the Army Materiel Command in St. Louis. For twelve years the District had handled this responsibility at the rate of approximately $10,000,000 per year.[27]

In 1951 a more significant change came, however, when the OCE gave the District responsibility for military construction, military real estate and related matters in most of Texas. The boundary for military construction coincided with the area for civil works and included Carswell Air Force Base, Camp Swift and Camp Bowie. The magnitude of the program was evident when Congress that year passed the largest appropriation for military construction in war or peace. It totaled $5,768,720,000. From that gigantic sum Texas received $390,000,000 for a variety of projects. A large portion went for barracks and housing to accommodate the increase in the number of troops. Large sums were also earmarked for expansion of air bases. About $45,000,000 per year were designated for military construction in the District during the conflict.[28]

[27] "Brief History of the Fort Worth District," March 24, 1960, typescript, FWD Library; Memorandum, Transfer of Military Supply Mission, June 23, 1963, Box 151, FWD Storage.

[28] Minutes, Historical Committee, FWD, March 2, 1973; Memorandum, Military Construction (N.D.), Box 151, FWD Storage; Fort Worth *Star-Telegram*, August 15, 1951; "Brief History of FWD."

Pressed by these new tasks, Colonel Freeman requested an additional 200 employees to help with the increased workload. Approval of the request was questionable because of the severe strain imposed on the national Treasury by the conflict. To justify the request, John Sheffield and Executive Officer Clayton Lyle prepared a brief by going through the *Congressional Record* and quoting every Congressman and Senator who made a statement about the military situation in Korea. The tactic worked. The new 200 slots made the FWD one of the largest in the United States.[29]

In the meantime work on civil projects continued. Congress permitted those sites where construction had already started to proceed according to the pre-conflict schedule. Civil projects still in the planning stage, however, were slowed down by the shortage of funds. Construction of the Dallas Floodway, for example, was delayed for three years for this reason. The investigation report of the Sabine River initiated in 1950 was suspended "owing to the curtailment of funds for investigational purposes."[30] Congress was determined not to let the conflict interfere with reservoir projects, and when the armistice with North Korea was reached in 1953, Congress quickly authorized new dams in Texas through the Flood Control Act of 1954: Somerville, Waco, Proctor, Navarro Mills, and Lampasas. The Korean conflict thus extended the boundaries and scope of operations of the District, but did not significantly interfere with civil works.[31]

For the rest of the decade military construction continued to occupy much of the time and energy of the FWD. The public strongly supported military preparedness during the 1950's for several reasons. For one thing, the "cold war" with the Soviet Union convinced the public that a strong military posture was necessary. The moral and political atmosphere of the decade, furthermore, was conducive to large-scale military installations. It was during this period that "McCarthyism" flourished, which placed heavy emphasis on military power. Not to be overlooked was the support of the military by President Eisenhower, former

[29] Minutes, Historical Committee, March 2, 1973.

[30] "Sabine River," Survey Report Files, 1957, Box 56, FWD Storage.

[31] Ibid.; Project Information Sheet, Box 56, FWD Storage; Delbert Freeman to Herbert D. Vogel, November 21, 1952, "In Person Files," Box 72, FWD Storage.

commander of the Allied Forces in Europe during World War II. The Texas congressional delegation firmly supported military preparedness and sought to have bases and other improvements located in the Lone Star state. It was only natural, therefore, for the FWD to continue to receive military projects.

Construction of Dyess AFB at Abilene was indicative of the American commitment to military preparedness and the high level of military construction by the FWD. In 1951 the Strategic Air Command (SAC) was established as the main deterrent force in the American arsenal. The SAC used the B-47 Stratojet, but by 1953 the SAC began to employ the giant B-52 bombers which had a greater "payload" and longer range. Because of its immense size and weight the B-52 required longer and thicker concrete runways. To supplement Carswell AFB at Fort Worth, the SAC searched for a site to locate a new base, fully equipped to accommodate airborne refueling tankers as well as the B-52's. In the meantime the citizens of Abilene, Texas, wanted a military installation at their city.[32]

Representatives of the town made no progress until, by accident, they talked to an officer of the Corps of Engineers in a Waco restaurant. "You boys are wasting your time talking to anybody but the SAC," he told them. The SAC had an expansion program underway and wanted "lots of land" he informed them. With this information the Abilene delegation took their case to Omaha, the SAC headquarters. Soon Brigadier General H. R. Maddux went to Abilene and attended a public meeting in support of a SAC base. The townspeople promised to contribute $1,000,000 toward the construction of the base. When the money was raised, the SAC agreed to locate a base at Abilene. Thus, Dyess AFB came into existence.[33]

The FWD inherited the task of building the base. Originally a small Army Air Corps field was located there and later was renamed Tye AFB. Until it was designated as a SAC base, however, Tye AFB was a small installation. Dyess AFB, therefore, was the first and only base built "from the beginning" by the FWD. Engineers remembered Tye as nothing more than an open field.

[32] William F. Ryman to SWD, August 4, 1971, SWD files.
[33] Fort Worth *Star-Telegram*, October 20, 1955.

Local interests strongly supported the Air Force and the FWD. The city of Abilene deeded 1,530 acres to the federal government, and the Real Estate Division acquired another 4,558 acres for the base. The city had one stipulation about construction specifications—it wanted the exteriors of all walls to consist of cherokee mingled brick for aesthetic reasons. It was agreed, however, that the buildings adjacent to the flight line be made of reinforced concrete. Brick exteriors were against Corps regulations, but the Chief's Office in Washington approved them. The local cash contribution amounted to $350,000, which was used to build a plush "VIP" quarters replete with swimming pool. In 1953, when groundbreaking ceremonies were held, Colonel H. R. Hallock commanded the FWD.[34]

For three years the FWD labored to finish the base. Total funds for construction were expected to reach $70,000,000. It was the largest single construction job, civilian or military, between Fort Worth and El Paso. In 1954, Congress appropriated $14,675,000 to begin work. Texas Bitulithic Company received a $5,000,000 contract to build the landing strip, runways and taxiways for the aircraft. The runway was the maximum length set by the Air Force. Other contractors swiftly began to erect a small city with housing, water storage and sewage plants, recreation and educational facilities, warehouses, aircraft hangars and numerous other buildings. Dyess AFB was the largest single construction project of the FWD at the time.[35]

In 1956 the base was dedicated and renamed after William E. Dyess, a P-38 pilot killed during World War II. The Japanese had captured Lieutenant Colonel Dyess, and he was part of the Bataan Death March. He escaped on a submarine and returned to Australia. His account of Japanese atrocities was serialized in American newspapers. He died in 1943 when his P-38 caught fire over the populated Los Angeles area, and he guided the aircraft to a vacant field instead of parachuting. He died a war hero.[36]

Toward the end of its first decade of operations the FWD became involved in the construction of launching pads for guided missiles. In 1957 the United States Army designated the Fort Worth-Dallas metroplex a major strategic area because of the

[34] Ibid., September 19, 1953; Map Files, Real Estate Division, FWD.
[35] Abilene *Report-News*, May 21, 1954, July 4, 1954.
[36] Fort Worth *Star-Telegram*, April 15, 1956.

large amount of aviation and industry there. Nike-Hercules ground-to-air missiles with a conventional warhead and a range of seventy-five miles were placed in the perimeter of metropolitan areas in the United States. A liquid-fuel rocket, the Nike was solely a defense weapon designed to strike down enemy aircraft.[37]

To protect the two cities, four sites for the launching pads were selected: Terrell, Alvarado, Denton and Mineral Wells. At each site three missile silos were built along with radar tracking equipment. For each installation about thirty acres were required. Cost of land acquisition, plus construction, was estimated at $1,500,000 per site. Each site was also designed to permit the installation of nuclear missiles at a later date.[38]

In early 1958 the FWD began operations to build the sites. Altogether the Real Estate Division needed to acquire 120 acres, but at Alvarado opposition developed. Several landowners refused to sell their land, and the District brought condemnation suits against them. Except for this resistance, however, the FWD and the missile program were popular with the public. Each site consisted of three silos thirty feet deep and made with reinforced concrete. A radar station, a control van which served as the nerve center of each installation, barracks for about 100 men and a dining hall were also included at each of the four sites. In 1959 Abilene was selected for two Nike launching sites, though the reason was unclear since Abilene was not a major metropolitan area.

The FWD finished the sites on schedule. Alvarado was the first to begin operations. A short time later, however, a more complex missile system, the Atlas, was installed. It was an Intercontinental Ballistic Missile equipped with a nuclear warhead and outdated the Nike. In 1968 the Nike sites were abandoned.[39]

Exemplifying the gigantic proportion of military work assigned to the FWD was the construction and development of Fort Hood, the largest Army training center in the United States. The physio-graphic characteristics of Fort Hood offered several advantages for training armored divisions, particularly tank troops. Rolling prairie and ridges transcend the area from

[37] Ibid., April 21, November 3, 1957.

[38] Minutes, Historical Committee, March 2, 1973; Fort Worth *Star-Telegram*, October 10, 1958; ibid., April 16, 1959; ibid., June 8, 1960.

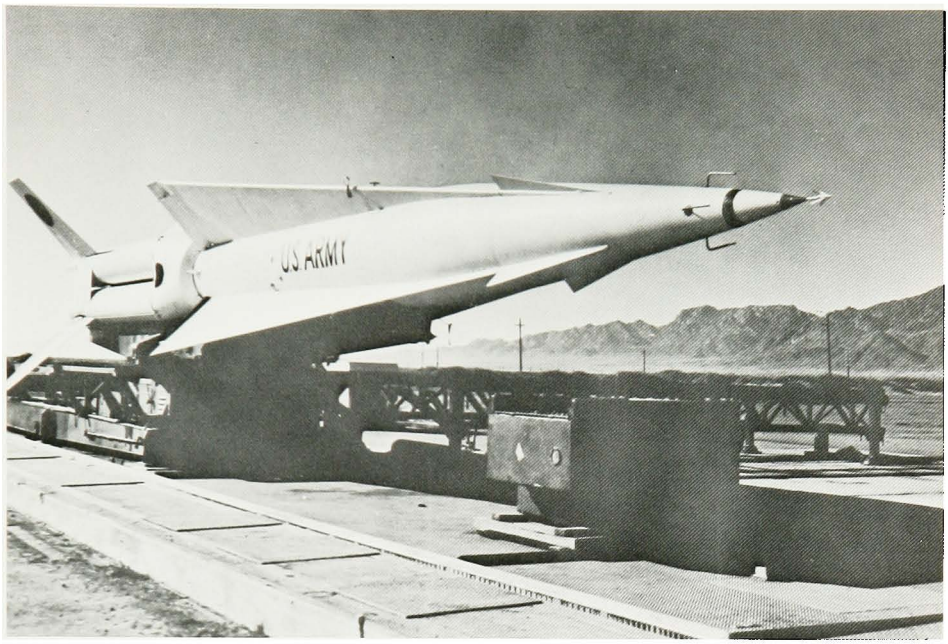
[39] Ibid., July 17, 1972.

northwest to southeast, and the soil is hard caliche, ideal for sustaining the heavy weight of tanks. Mild winters enable training to continue twelve months of the year. It was for these reasons that the United States Army first established Camp Hood in 1941, naming it after John Bell Hood, commander of the Texas Brigade during the Civil War. For a short time after World War II it was not used, but in 1950 the Army gave the site permanent status and redesignated it as a Fort.

Immediately a heavy construction program started to replace the temporary buildings with permanent ones. In 1952 the FWD received the responsibility to build the Fort from the Galveston District. That year Congress had appropriated $11,000,000 for construction of the Fort. Large-scale development continued for several years, and like many military installations, Fort Hood resembled a self-contained city. The FWD equipped it with full facilities for housing, medical care, recreation, education, commissaries and training facilities. Three theatres were built. By 1956 the District acquired another 49,668 acres to enable training maneuvers with a new tank equipped with 120 M-M guns. Total land area amounted to 340 square miles. "The construction of Fort Hood," wrote one FWD official, "is one of the greatest achievements of the Fort Worth Army Engineer District in its brief history."[40]

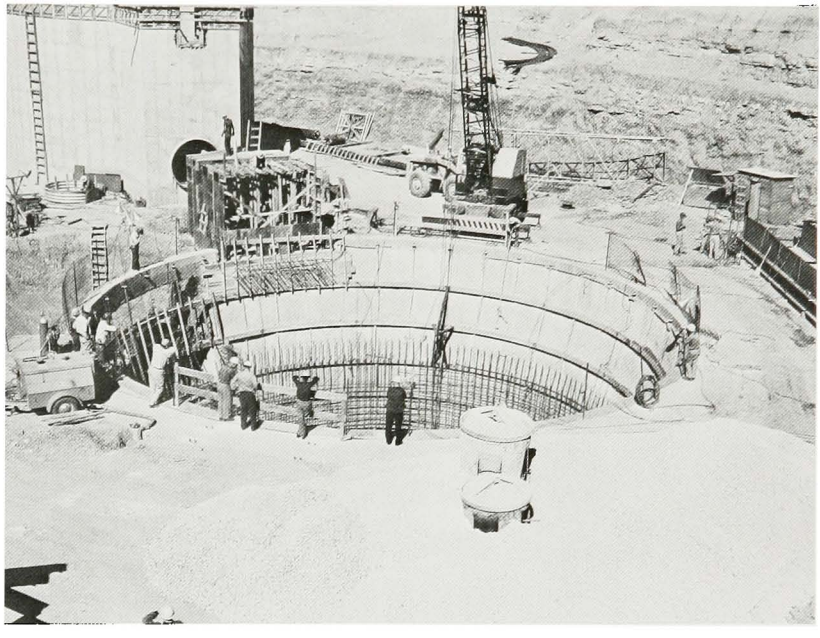
Toward the end of the 1950's weapons became more sophisticated and some were quickly outdated. Such was the case with the Nike missiles. They were defensive weapons designed to destroy enemy aircraft within a short distance of its target. For a more effective deterrent the United States employed an offensive system using nuclear weapons—the Intercontinental Ballistic Missile (ICBM), the Atlas, capable of delivering a warhead into the heart of the Soviet Union. The Atlas F was an awesome weapon. It could travel 16,000 miles per hour, covering the 9,000 miles to Russia in thirty minutes. Each warhead contained more explosives than that released during World War II, including the two atomic bombs dropped on Japan. The Atlas guidance system "zeroed-in" on the North Star and could deliver the weapon within five miles of the target. Once fired, the missile could not

[40] Quote in Craft, "History of the FWD," p. 164A; *Hearing Before the Real Estate and Military Subcommittee of the Committee on Armed Forces*, Senate, 83rd Congress, 1st Session, June 24, 1953.

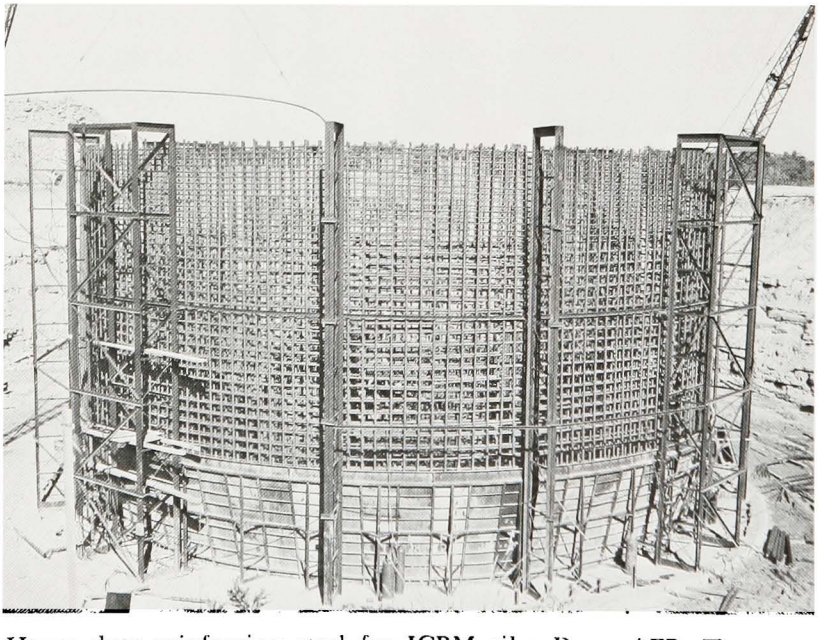


A Nike Missile.

A tank crew at Fort Hood, Texas. (United States Army photograph)



ICBM silo under construction, Dyess AFB, Texas.



Heavy duty reinforcing steel for ICBM silo, Dyess AFB, Texas.

be destroyed, nor could its path be diverted. Elaborate ground facilities were used to supply, maintain and fire the missile. Probably the most complicated aspect was the Propellant Loading System (PLS), the highly technical means by which the rocket was fueled. The task to build the PLS in Texas and the rest of the United States fell to the FWD.[41]

A total of seventy-five Atlas launching sites were built in the United States. Each was an underground unit consisting of a silo 174 feet deep and 52 feet wide to hold the missile. Attached was an underground bunker, the control center which housed the crew of five. An elaborate system of communications, fuel storage and other highly complicated supportive apparatus was part of each unit. The whole structure was encased in extra-heavy concrete and steel. Reinforcement rod for the concrete wall was as large as a man's arm, and the entrance doors to the underground bunker were 2½ feet thick and made of solid steel. They could be opened only from the inside. Theoretically the unit was supposed to withstand a nuclear blast.[42]

The Atlas F installation program involved other Corps of Engineer Districts besides the FWD. But the latter played a major role since it handled the PLS for all the missiles in the United States, and it assisted with the construction of twelve missile sites at Dyess AFB. Abilene had the only Atlas installations in Texas.

Headquarters for the construction program was at the Los Angeles Field Office (LAFO), a specially created division of the Los Angeles District. The FWD participated with LAFO in the initial stages of the program, but LAFO was superseded by the Corps of Engineers Ballistic Missile Construction Office (CEBMCO) which handled construction of the sites at Dyess AFB. Personnel from the FWD assisted them.[43]

For the FWD the PLS was its main responsibility. PLS was the term used to refer to the complex fuel system of the missile. A variety of elements were required to fuel the rocket: a hydrocarbon resembling kerosene was the actual fuel, but liquid oxygen and helium were used to oxidize or regulate the hydrocarbon. Liquid-fuel rockets require constant monitoring

[41] Houston *Post*, January 21, 1961; Fort Worth *Star-Telegram*, August 20, 1961.

[42] Ibid.; John Chapman, *Atlas, The Story of a Missile* (New York, 1960), 7.

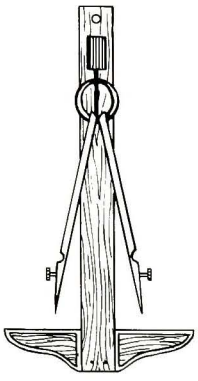
[43] Memorandum, Civil Works Contribution to the Organization of CEBMCO (N.D.), Box 151, FWD Storage.

because temperatures range from -297 degrees to 6000 plus degrees fahrenheit. When the rocket was fired, liquid oxygen, helium and the hydrocarbon were injected as raw materials into the engine for combustion. Successful firing depended on the maintenance of proper temperatures and the precise injection of fuels. Each PLS was prefabricated and installed in the silo. Two FWD staff members, Donald Denney and J. C. Comito, were in charge of the inspection and design of the PLS units. They participated in the research of the PLS because with each test firing of the missile the PLS was redesigned.[44]

At the Dyess AFB installations the FWD furnished services for CEBMCO such as providing motor vehicles, communications equipment and assistance personnel for a variety of purposes. Speed was essential since the Atlas would serve as America's deterrent to war. On one occasion Mr. Denney was ordered to spend his two-week summer reserve duty in his regular capacity as the inspector of the PLS units. By 1962 the Texas installations were finished, costing a total of $140,000,000. That same year the Atlas missiles became operational.

Participation in the Atlas program marked the beginning of the FWD's part in space technology and exploration. As the decade of the 1950's closed, the employees of the District could look back to almost ten years of work with a sense of accomplishment. The District had finished all civil projects inherited from the Galveston District in 1950 without a mishap. The Sam Rayburn Dam was under construction and it was designed to provide hydroelectric power. These reservoir projects had enabled large and small cities to survive the drought of the 1950's. They also prevented disastrous flooding in 1957. The outbreak of the Korean conflict had interrupted the civil work of the District, but only marginally. That loss was compensated by the large volume of work in military construction and procurement by the FWD. As the next decade opened, the District was larger in both geographic and operational scope and could look to the future optimistically. Plans were already underway for its most dramatic task.

[44] Donald Denney to D. Clayton Brown, Interview (telephone), July 20, 1977.



CHAPTER IV

The Johnson Space Center

When the American people awoke on the morning of October 4, 1957, their newspapers had a frightening headline: "Russia Launches Sputnik." Newspapers reported that the Soviet Union had sent into orbit the first artificial earth satellite. It was named Sputnik and weighed 184 pounds. This triumph of the Russians shocked the United States, for it implied that American technology had fallen behind. It also meant that the Soviet Union might have made advances in space weaponry that would enable her to control the skies. Sputnik fortunately had no military purpose, but the Soviet Union reaffirmed her superiority in space a month later by putting into high elliptical orbit another satellite weighing 1,120 pounds. The new capsule carried a dog name Laika. By contrast the United States had a Vanguard test satellite which only weighed three pounds. It was still on the test stand at Cape Canaveral, the American space launching site.[1]

Throughout the United States a spirit of concern and apprehension was evident. American leaders were depressed. The public was angry with the federal government, blaming the American lag in space on bureaucratic bungling, lack of decision and generally poor leadership. Not only did the Soviets have superior satellites, but their two orbital flights demonstrated the superior power and thrust of their ICBM's which could be used to

[1] Richard Hirsch and Joseph Trento, *The National Aeronautics and Space Administration* (New York, 1973), 14-15.

deliver atomic warheads. Thus, Sputnik destroyed the assumption that the United States led the world in scientific and engineering ability.[2]

The Republican Administration under President Eisenhower took steps to overcome the Russian lead. In September, 1958, Congress created the National Aeronautics and Space Administration (NASA) in order to centralize and streamline American space research. The new agency grew out of the National Advisory Committee for Aeronautics (NACA) which dated as far back as 1915. Though charged with the responsibility to establish superiority in space, NASA's immediate purpose and directive was unclear. The space program proceeded haphazardly.

The 1960 presidential election brought fresh impetus to the space race. Democratic candidate John F. Kennedy charged the Eisenhower Administration with poor leadership and lack of force in the push for American technological achievements. With Kennedy's electoral victory, the United States intensified its program of research and development. In May, 1961, NASA successfully sent astronaut Alan N. Shepard into a suborbital flight, but the Russians had already sent a cosmonaut through a full orbit a month earlier. For the sake of international prestige and restoring public confidence, Kennedy thought it imperative for the United States to enact a feat of unprecedented magnitude, enough to overshadow Russian technology. It was this last thought that motivated the President when he committed the nation "to take a clearly leading role in space achievement. This nation should commit itself," he insisted, "to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to earth."[3]

Congress had also been dissatisfied with American progress in space and welcomed Kennedy's urgent call for a lunar landing. In the summer of 1961, therefore, Congress with strong public support appropriated funds for NASA to begin work toward that achievement. Within a few months after the congressional approval, NASA started a massive construction program along the Gulf of Mexico and the Atlantic, an area called the "NASA Crescent." In addition to the launch site at Cape Canaveral at

[2] Oscar Barch, Jr,. and Nelson Blake, *Since 1900: A History of the United States in Our Times* (New York, 1974), 626.

[3] Quoted in Hirsch and Trento, *National Aeronautics and Space Administration*, p. 95.

Florida and a series of research and test sites in various parts of the country, NASA planned to build a Manned Spacecraft Center (Johnson Space Center) which would serve as the principal training facility for astronauts and the control center for the lunar flight.[4]

The American space program was, therefore, started with a great sense of urgency. It was necessary for NASA to utilize to the fullest extent the resources of the United States and to draw upon the talents of private enterprise as well as other federal agencies. Since large-scale construction was necessary, NASA delegated that responsibility to the Army Corps of Engineers instead of handling construction itself. Logic dictated the decision to incorporate the Corps into the space program since it had a long history of construction supervision and management. Construction of the Johnson Space Center (JSC) at Houston fell to the FWD and thus began one of its most complex and frustrating assignments since beginning operations in 1950.[5]

From the beginning three critical qualifications were imposed on the FWD: speed, cost and the highly technical nature of the work. To land a man on the moon required research into unknown technological areas, and NASA sometimes had to require the District to construct buildings without providing full specifications. The FWD, for example, began pouring the foundations for the Mission Control Center, Building No. 30, while engineers of the Philco Corporation at Palo Alto, California, still worked on the building's design. "We were in the realm of the state-of-the-art," recalled one District employee, "and did not know what the results of our design would be."[6] For this reason, plus the fast schedule and budget ceiling imposed by Congress, the relationship between FWD and NASA was strained at several points.

An omen of the difficulty in building the JSC was the selection of Houston as the site for the control center. NASA established the following criteria for the location of the laboratory and training facility: the JSC had to be near a city with universities known for their technical expertise; the site had to be close to sophisticated medical facilities; it would have to be near a large

[4] Tom Alexander, *Project Apollo: Man to the Moon* (New York, 1964), 14.

[5] Stephen B. Oates, "NASA's Manned Spacecraft Center at Houston, Texas," *Southwestern Historical Quarterly*, LXVII (January, 1967), 356.

[6] James L. Ballard, Interview, NASA-MSC Historical Files, p. 4.

body of water for transporting large cargoes; mild weather for twelve months per year was necessary; an adequate labor source with technical and engineering talent was mandatory; and the area would have to offer recreational and cultural assets for the sophisticated personnel employed at the JSC. About twenty cities were examined, including Boston, Los Angeles and New Orleans, but Houston met each of the criterion. To entice NASA to locate at Houston, Rice University donated a 1,000 acre tract of land on which to construct the Center. "Houston more than meets the criteria established for the laboratory," a member of the NASA inspection team told reporters. A short time later, NASA formally announced an area known as Clear Lake as the spot to build the control center of the space program. Clear Lake was about twenty-two miles southeast of Houston.[7]

Political influence was also a determining factor. Houston's own Representative in Congress, Albert Thomas, was Chairman of the House Appropriations Committee that handled NASA's funding. Texas Representative Olin Teague was Chairman of the House Subcommittee on Manned Space Flight, and Vice-President Lyndon B. Johnson, long-time Texas Senator, was Chairman of the National Space Committee. Despite these obvious advantages, "it was the winning combination of advantages," wrote one historian, "which Houston itself had to offer."[8]

Selection of the southern site irked some Yankee municipal figures. Ephron Catlin, president of the Boston Chamber of Commerce, insisted that the states of Texas and Oklahoma had entered into a "well-conceived plot" to make Texas the center of space activities. By selecting Houston, Catlin argued, the space program would be set back. Boston allegedly had more scientists and engineers, and "I don't think Houston, with its 'Jim Crow civilization' is going to be able to draw them," he added.[9] At the time NASA was headquartered at Langley Field, Virginia, and some space personnel grumbled about the move, but these expressions of dissatisfaction quickly disappeared. The Corps of Engineers at Fort Worth faced more practical considerations.

[7] Fort Worth *Star-Telegram*, August 21, 1961; Oates, "NASA's MSC at Houston," pp. 354-356.

[8] Ibid., p. 355; *Newsweek* (October 2, 1961), 84.

[9] Ibid., Fort Worth *Star-Telegram*, October 4, 1961.

The Corps of Engineers received formal assignment for design and construction of the JSC when James Webb, NASA Administrator, wrote Lieutenant General W. K. Wilson, Jr., Chief of Engineers, in a letter dated September 22, 1961. The Chief in turn selected the FWD to perform the job. It was the latter's experience in military construction, especially the Atlas F missile program, that caught the attention of the Chief. But the Corps had taken steps prior to Webb's assignment in hopes of participating in the space effort. In late 1960 the Office of the Chief of Engineers had approached NASA and offered to serve as their construction agent. The Corps pointed to its construction of Air Force missiles and the Army Ballistic Missile Command at Huntsville, Alabama, as an indication of its experience in a highly technical field. NASA realized, furthermore, that it would have to develop an inhouse construction capability and that within five years the personnel would have to be reassigned or released. "This was the principal factor," recalled one observer, "that led NASA to use the Corps as its construction agent."[10]

Because the space program was a coordinated effort by several federal agencies, the Corps was thrust into a new position. Another agency, namely NASA, drew up the construction specifications, but the Corps, specifically the FWD, had to transform these into a real physical structure. The latter also had to handle the administration of the designs, the actual contracting and the inspection. NASA had created its own Construction Division at the JSC and it was headed by Leo Zbanek. NASA also controlled the money. For the next four years, the FWD was in a frustrating position since it had responsibility for erecting the site at Clear Lake, but had to accommodate not only NASA's procedural routine but also the numerous modifications requested by the scientists. This overlapping of jurisdiction created some administrative difficulties.

Participation by the FWD began only three days after Administrator Webb requested the assistance of the Corps. On September 25, 1961, NASA asked the FWD to arrange preliminary topographic and utility surveys of the site. NASA advanced $125,000 to the District for this particular task. Humble Oil and Refining Company, which had ownership of the land at the time, granted rights-of-entry. A short time later Humble deeded the site

[10] F. P. Koisch, Interview, NASA-MSC Historical Files, p. 2.

to Rice University which immediately donated it to NASA.[11]

A critical meeting was held in Fort Worth on October 3, 1961, with NASA representatives. Plans concerning funding, criteria requirements and the physical arrangement of the site were discussed. It was at this meeting, furthermore, that NASA requested the Real Estate Division to acquire another 560 to 600 acres for the site. Dr. Robert Gilruth, Director of the JSC, explained that the Anechoic Chamber needed a radar field range free of competing radar frequencies. The purpose of the Chamber was to create an environment totally free of noise. District and NASA officials also discussed a priority of construction and the selection of an Architect-Engineer (A-E) firm. They agreed to minimize "on-site" labor, meaning that pre-job construction would be followed whenever possible so as to increase the rate of speed.[12]

Selection of the A-E firm was a critical decision because that would be the company that would actually draw up the architectural plans and also build some of the buildings. Only a handful of companies in the United States were capable of handling the magnitude and complexity of the JSC. NASA had gathered information from approximately 175 A-E firms and submitted them to the FWD. The two agencies set up a selection committee. For two to three weeks the committee sifted through the data and presented three companies for further review: (1) Kaiser-Warnecke of Oakland, California, (2) Parsons-Becket-Johnson of Houston, and (3) Brown and Root, Inc., of Houston. NASA had intended to incorporate local talent and labor as much as possible for the Apollo project, a decision dictated by economic and political considerations. In December, the FWD in cooperation with NASA awarded the A-E contract to Brown and Root.[13]

As the basic design of the Center began, NASA made several requests. It wanted the site to have a "campus appearance" so as to create an atmosphere of research. The new agency hoped to reduce the scientific air of the JSC into humanistic terms. "It ought to be an environment that would inspire developmental

[11] F. P. Koisch, (Notes on MSC) undated, typescript, pp. 1-2, Installation Historical Files, Records Management, FWD.

[12] Tom Conger to D. Clayton Brown, Interview, August 3, 1977.

[13] Koisch (Notes on MSC), p. 2; Fort Worth *Star-Telegram*, December 12, 1961.

thinking of the people it housed," one NASA official stated, "it should not be a factory type environment, it should be an inspirational environment."[14] NASA suggested, therefore, that particular attention be given to landscaping and that three small ponds, each with an island and cypress trees, be incorporated into the design. To facilitate movement and the humanistic atmosphere, NASA wanted a mall with several buildings incorporated into the Center. Weather also affected the basic design because hurricane Carla, the most vicious in recent times, had struck directly at the Clear Lake area in September. Carla had flooded portions of the 1600 acre site. It was necessary for the grade elevation of each building to be one to two feet above the normal ground level. Windows were specially tested before installation to withstand 120 mile per hour hurricane force winds. NASA asked the FWD to dig a barge canal linking the site to Clear Lake. The new agency expected to bring large spacecraft to their Houston headquarters for experimentation and wanted barge traffic capabilities.

For all parties concerned, the JSC was an unusual project. The eyes of the world were watching, and the prestige of the United States was at stake. Thus, the lunar space program had top priority. Exemplifying this sense of importance was the cooperation of the Houston labor force. Since speed was essential, labor leaders agreed to provide as much cooperation as possible; strikes would be avoided. Usually union labor was used, but Brown and Root utilized some non-union workers. Arrangements were made, however, to accommodate both types of workers. During the five years of construction, only one small stoppage occurred. One morning the painting contractor brought in non-union workers and the regular painters refused to work. After four hours of negotiations, the non-union painters left and work resumed. The cooperation shown by labor was owing to the urgency of the project and the "limelight" shown on the JSC. For the sake of public image, labor leaders wanted to cooperate.[15]

With NASA's basic design requests in mind and the principal A-E firm selected, the FWD went to work on a Master Plan. From November, 1961, through January 3, 1962, District employees and

[14] Leo Zbanek, Interview, NASA-MSC Historical Files, p. 24.
[15] Max Lechter to D. Clayton Brown, Interview, August 9, 1977.

personnel at Brown and Root worked at a feverish pace to draw up the Plan. The FWD also had to recruit employees with special skills from other Districts. Colonel R. P. West, the District Engineer at Fort Worth, instructed the staff to follow the procedures developed by CEBMCO in handling the prequalification of bidders. The District and NASA agreed to organize construction of the Center into three phases: (1) the utility, road and elevation grading work, (2) the construction of roads, parking lots and miscellaneous utility plants as the water treatment plant, sewage lines, heating and cooling plants and the construction of a 138 KVA power substation, and (3) all remaining site development including the buildings. Two more phases were later incorporated for the more complex structures. It was decided, for example, that the design and construction of Environmental Chamber A should be handled separately. Chamber A was the five-story capsule wherein the astronauts would work in a weightless atmosphere. This device became a focal point of the FWD's experience in the Apollo project.[16]

During the month of December the real action was centered at Brown and Root's offices in Houston. Five other participating architectural firms moved into Brown and Root's offices and set up a task force. Brown and Root had given full responsibility for the JSC to William Rice, who proceeded to work closely with both the Corps and NASA. These three parties held a meeting at least once per week in the company's offices, usually on Wednesday, for the next five years. The organizational structure was unusual because the FWD bore the responsibility to oversee Brown and Root, but NASA ordered the specifications and modifications. Final approval on the work also rested with the latter. For the Master Plan and Architectural Concept, Brown and Root had retained Charles Luckman Associates at Austin, Texas.

On the eve of the Christmas holidays in 1961, Luckman Associates had encountered several problems requiring clarification and solution by NASA's ranking authorities at Langley Field, Virginia. NASA tried to arrange a meeting at Langley Field, but the officers had already left for the holidays. Finally on January 4, an amazingly short time since the A-E contract was awarded, Luckman Associates presented the Master

[16] "Design Analysis of Manned Spacecraft Center," NASA-MSC Historian's Office, pp. 1-15.

Plan. NASA approved the Plan, but requested a second presentation in Washington, D. C. for James E. Webb, NASA Administrator. This presentation was made by Colonel West and Mr. Luckman. In the meantime surveys for foundation core holes had started. Soil engineer S. J. Stovall reported that two-foot auger holes filled with water overnight because of the high water table at Clear Lake. Special foundations had to be built so as to accommodate the mushy soil. To save time NASA's Construction Facilities Division had fallen into the practice of by-passing the FWD and going directly to Brown and Root to discuss changes in construction. In as much as the FWD had responsibility for the site, Colonel West requested that NASA channel its future modifications through his agency. This need to move rapidly ahead and still honor bureaucratic procedures exemplified the difficulties the two agencies faced.[17]

With Administrator Webb's approval of the Master Plan, the design work became more specific and detailed. On January 23, 1962, Brown and Root submitted preliminary plans and specifications for the first construction contract. Copies were immediately sent to the NASA Facilities (Construction) Division. The Facilities Division failed to return its review. Faced by the rapidly approaching deadline for completion of the design Plan, the FWD instructed Brown and Root to proceed with the plans based on the Corps' comments. A short time later the Facilities Division submitted "sketchy" comments.[18]

According to schedule, Brown and Root submitted their work for review on February 6. During this period NASA had difficulty in recruiting skilled personnel according to its timetable, which partially explained the new agency's inability to furnish the A-E firm and the FWD with definite comments and specifications. The FWD faced the same problem. "The Corps itself lacked this scientific talent," reported Colonel F. P. Koisch who succeeded West as the District Engineer beginning in November, 1962.[19] The difficulty of both agencies to recruit scientists and engineers was owing in part to the crash schedule imposed by the "race for the moon." NASA had to work out its own arrangements for the

[17] *Architectural Record* (January, 1962), 148; Jack Shields to D. Clayton Brown, Interview, July 29, 1977; Koisch (Notes on MSC), pp. 5-6.

[18] Ibid., pp. 6-7.

[19] Ibid., pp. 4-5.

use of buildings, but the A-E company had already begun the design. NASA changed floor plans, for example, on a day by day basis. Constant modifications drove up the cost, but Congress had imposed a tight budget, limiting NASA's funds for fiscal year 1962 to $60,000,000. When Brown and Root submitted the detailed Master Plan the cost ranged between $175,000,000 and $200,000,000. It was necessary to make drastic revisions. The barge canal was dropped in order to save money. Complaints from the Texas Fish and Wildlife Commission and local residents over the plan to dredge Clear Lake also caused NASA and the FWD to eliminate the canal. Later in 1971 the canal was built by the Galveston District. To reduce costs a proposed heliport was dropped. Houston Lighting and Power agreed to absorb some costs by extending its feeder lines. Concrete pan joists were replaced with standard steel construction. Buildings were relocated so as to reduce the length of underground utility tunnels. Some access roads were deleted. Sewage lines were reduced by relocating the Sewage Treatment Plant. Finally the cost dropped within NASA's budgetary range, and the greatly revised Plan was labeled "Scheme J-3." This revision of the Master Plan, however, delayed progress.[20]

Because of the different nature of the two agencies, one involved in research while the other dealt with construction, communications were sometimes difficult. To combat misunderstandings, they agreed to hold daily meetings so as to hold to a minimum the number of mistakes and delays. Without such an arrangement, the delays would have been far worse.

The delay of the Master Plan caused Brown and Root to request a negotiation for an extension of time and monetary increases to fulfill its contract. The FWD sympathized with the firm, but wanted to meet the original deadline. After six to eight weeks of negotiation, the two parties reached a satisfactory extension.[21]

In the meantime work had progressed. Complicating matters, however, were the protests from the brick industry which opposed the use of prefabricated concrete walls. Allegedly one executive of the industry had access to President Kennedy and used his

[20] "Background and History of Development of Master Plan and Architectural Concept for Construction of Facilities," typescript, p. 5, Box 804, FWD Storage.

[21] Ibid., p. 5; Koisch (Notes on MSC), p. 7.

influence to gain a reconsideration of the Master Plan. But the FWD and NASA explained the advantages in saving time with prefabricated concrete and the effort to use brick failed. But the interference cost time, and the private firms engaged in the design planning wanted monetary compensation for losses of time. NASA wanted to oppose such compensatory rewards, but the FWD insisted that the contractors were entitled to them.[22]

The history of the planning and design of the Environmental Testing Laboratory demonstrated the inherent difficulties for all agencies and parties involved in the Apollo project. Four space chambers were planned, but the heart of the laboratory was the Space Environment Simulator, known as Chamber A. Described by one writer as "a big milk can," Chamber A was to create the outer space atmospheric conditions of temperature, pressure and solar light for testing spacecraft, equipment and astronauts. It was definitely a project "beyond the state of the art." The Chamber had to be five stories high so as to accommodate the spacecraft. A vacuum had to be created in order to simulate the lack of pressure in outer space. Special cryogenic panels would line the inside walls in order to draw the elements from the air—molecules of nitrogen and oxygen. Carbon arcs would be used to simulate the sun's rays in outer space where they are parallel. It was also necessary for the device to have a rotating floor with a perfect seal for the spacecraft to revolve through darkness and light as if in space. Temperatures inside the Chamber had to range from a low of -250 degrees to a high of 2000 degrees fahrenheit. It would be the only "man-rated" simulation chamber in existence, meaning that astronauts could train and work inside. A smaller facility, Chamber B, was also built, but it was only three stories high. Chamber A challenged American technological expertise; it also perplexed the Corps of Engineers.[23]

In the early planning stages the FWD and NASA had agreed to award separate A-E contracts for Chamber A. The FWD had no personnel capable of handling this particular item and recruited the services of Harry Lowe from the Chief's Office in Washington. He administered the selection of the A-E firm and preliminary design plans of the Chamber. After careful selection,

[22] Zbanek Interview, p. 15.
[23] NASA, *Technical Facilities Catalog*, NHB 8800.5(II) (March, 1967), pp. 11-15.

the Bechtel Corporation of San Francisco was awarded the contract. Bechtel, however, subcontracted the actual work to the Chicago Bridge and Iron Company which was known for its expertise in this area. A separate contract was awarded by the FWD to a construction company for the building to house the device. As was the case with the original Master Plan, Bechtel's first concept design placed the cost at $60,000,000. NASA only had $19,000,000 for the laboratory, and Chambers C and D were deleted. Chambers A and B were placed in the same building.[24]

Equally exotic and perplexing was the construction of the centrifuge, the specially designed acceleration facility to test the astronauts' tolerance to extreme gravitational pull—the G's. The centrifuge was a shiny stainless steel sphere at the end of a steel arm fifty feet long. The whole device would spin around in a large round room over 100 feet in diameter at the rate of 28-30 rounds per minute. The sphere, or gondola, had to have a vacuum atmosphere. It would be the largest centrifuge in the United States. The FWD and NASA again agreed to award separate A-E contracts. Lockheed was the prime contractor, but the Rucker Company built the gondola. The "gimbal ring" which supported the three man gondola provided the greatest technical challenge.[25]

Other features of the JSC were exotic, but presented fewer problems. The Anechoic Chamber was a technically advanced facility, but "did not push the state of the art," wrote one observer, "as did the space environment simulation laboratory and the centrifuge."[26] Through a specially hired consultant the FWD maintained a close inspection of the Anechoic Chamber which probably prevented errors and mistakes through the course of construction.

By August, 1962, Brown and Root had advanced the designs to the point that Phase I of the construction could start. A FWD area office was established at Houston with a full contingent of employees. Lieutenant Colonel Wayne Blair was designated the Deputy District Engineer and was stationed at the site. His staff

[24] "Background and History of Master Plan," p. 8.

[25] Conger to Brown, August 3, 1977.

[26] R. B. Merrifield, "Chapter VII-VIII of the MSC Narrative History," typescript, February 22, 1971, pp. 16-17. For research material on this chapter, I am indebted to the work of Merrifield.

included Resident Engineer Don Mills and field engineers Jack Shields and John Putnam. Sam Martin was Chief of the Engineering Project Office. James L. Ballard, Jr. served as Chief of the NASA Section, Project Management Branch. Omar Gagnon was the Office Engineer. A staff of engineers, inspectors, clerks, secretaries and other employees rounded out the FWD contingent at Clear Lake. A full-time labor relations man was kept on the job. At the peak workload the District had about 100 employees at the site.[27]

During its first twelve months of work on the JSC, the FWD had developed a plan of action and handled the design and planning stages of the project. A wide variety of unanticipated problems had arisen, ranging from the lack of well defined procedures between two agencies to overt political influence. Chiefly responsible for the difficulties, however, was the rush to complete the project. According to Colonel Koisch, "the major portion of the problems encountered could be charged largely to the extremely short period of time initially allowed for the project."[28] NASA's conception of the JSC was, furthermore, slow to develop because of the difficulty of space research. Personnel for the project had not been selected when the design planning started, and they often changed specifications after joining the NASA staff. The FWD was sometimes unable to obtain expert personnel fast enough to fulfill its obligations. By October, 1962, construction was, nonetheless, underway, though the design and planning work continued. The first stage of the FWD's role in the Apollo project had passed.

As soon as the FWD received notice to assist NASA, the Real Estate Division began to obtain rights-of-entry. When NASA realized it needed another 600 acres, the Division conducted appraisals of the additional acreage. Negotiations with the landowners were conducted and acquisitions proceeded smoothly. There were no difficulties in this aspect of the project, and after acquiring the extra land, the Division assisted NASA in preparing out-grants upon request.[29]

Relocation of utility lines was another phase of the project that

[27] Beth Clark to D. Clayton Brown, Interview, July 26, 1977; Jack Barber to D. Clayton Brown, Interview, August 10, 1977.

[28] Koisch, (Notes on MSC), p. 10.

[29] John Gearheart to D. Clayton Brown, Interview, August 10, 1977.

went smoothly. Several utilities—Southwestern Bell Telephone, Humble Oil and Houston Lighting and Power—had easements on the site. The FWD appraised and negotiated settlements with them. These contracts were executed by May 14, 1962.[30]

It was the responsibility of the Corps to obtain natural gas and electric service for the JSC. The deadline for installation of service was spring, 1963. Several companies already had facilities in the Clear Lake area, but the FWD concluded that the Houston Pipe Line Company furnished the most favorable gas rates. A contract with the firm was made on August 17, 1962, and construction began. For electric service the District decided that Houston Lighting and Power had the only available source of energy for the site. Two generating plants were near the site, enabling the company to provide reliable service. Houston Lighting and Power built a substation and served the Center at standard commercial rates. Again there were no serious impediments in arranging electric service.[31] Actual work on Phase I began March 29, 1962, when the District awarded a contract to Morris-Knudsen and Paul Hardeman. The amount was $3,673,000. This phase included relocation of a small discharge canal from one of the two generating plants near the site operated by Houston Lighting and Power. Storm drains, water supply lines, sewer lines, roads, parking lots and some rough grading were also included. The main utility tunnel was installed. Completion of the streets and roads was a wise move because it enabled the construction companies that came later to move with greater ease and speed. "Building was not hamstrung," wrote Leo Zbanek, "by having to haul our materials over a mud path."[32]

Phase II resembled the previous one. It was awarded September 10, 1962, to a joint venture of W. S. Bellows and Peter Kiewit for the amount of $4,145,044. Phase II included Building No. 12, the Central Data Office; Building No. 322, the Water Treatment Plant; Building No. 223, the Sewage Treatment Plant; Building No. 24, The Central Steam and Chilled Water Plant; and Building No. 25, the Fire Station. Additional roads and parking lots and the asphaltic concrete surfacing of existing roads were completed. Miscellaneous site preparations were also conducted.

[30] Koisch, (Notes on MSC), pp. 15-16.
[31] Ibid., p. 17.
[32] Zbanek interview, p. 29.

This phase of construction witnessed the erection of the 138 KV substation and an adjacent structure, Building No. 221, which housed the controls and instruments for the electric power facilities.[33]

The amount of work and intensity of the FWD's involvement at the construction level was greatest during Phases III, IV and V. It was these phases that largely transformed the physical appearance of the 1600 acre marshland into its present status as a modern complex for space research. Phase III called for the construction of thirteen buildings primarily designed as offices and laboratories to house NASA personnel which at the time were scattered in some sixteen buildings throughout Houston and Ellington AFB. Phase IV and V consisted of the exotic and more sophisticated structures. When Phase III construction began, the exotic buildings were still in the design stage, but were started a short time later so that construction on the three latter phases occurred simultaneously. The construction stage of the FWD's role in the history of the JSC was as challenging as the earlier period when the design concepts were handled.

For the sake of organization and speed, the structures built during Phase III were divided into components according to the purposes of the buildings. Facilities with similar purposes, in other words, were grouped together. One component of Phase III was classified as the Flight Project Facility, a phrase referring to a nine-story office building, a data collection building, one cafeteria and an auditorium. This was probably the least glamorous component in the JSC except for the utility and sewage lines.

The auditorium, a two section structure, had 43,430 square feet and could seat 800 people. It had a display and public information area and was equipped for television broadcasts. For the most part, the auditorium was a visitor center. Building No. 3, the cafeteria, could serve 1500 dinners, 500 per each one-half hour lunch period. It had a private executive dining room with seating capacity for forty-five persons. One problem arose with the cafeteria that typified the FWD's difficulties at the Center. In the original design, there were two cafeterias, each having complete kitchen facilities. But NASA's budget would not permit two fully equipped kitchens, so the FWD and NASA had to

[33] "Background and History of Master Plan," p. 7.

redesign the two cafeterias in such a way that the kitchen facilities in the first would supply the second. Hot and cold food, in other words, had to be transported by truck from one cafeteria to another. By avoiding duplication of a second kitchen, NASA trimmed $250,000 to $300,000. These modifications, which were made after work had started, exemplified the steadily changing conditions imposed on the FWD.[34]

The nine-story building was the JSC's management office. It housed executive personnel, project offices and other center related functions. Total square footage was 196,950, enough to accommodate 1,000 people. A smaller three-story office building was also erected to house the engineers and scientists conducting research on the life support apparatus of the spacecraft. They concentrated on the astronauts' health and physical well-being, making observations and keeping records of the neurological, endocrinological and biochemical functions of the astronauts.

Component two of Phase III was the Equipment Evaluations Laboratories, nine structures in total. "These would provide," in the words of one FWD officer, "a complex of central services, including shop and assembly areas for the preparation and repair of space models and devices."[35] Scientists working in these buildings would focus mostly on space hardware, testing its capabilities and performance in space flight. Most of these buildings were smaller than the others in Phase III, ranging from a maximum of 93,230 square feet to a minimum of 16,800 square feet. These structures, like those in the first component, consisted of offices and laboratories. The second component, however, had machine shops, photographic film processing areas and other assorted technical and mechanical workrooms. This segment of construction included the large laboratory wherein space vehicles and spacesuits could be studied for such intricate research as analysis of trace contamination and particulate matter.

Speed was critical. Thanks to careful and deliberate planning at the design concept stage, the construction of the JSC proceeded rapidly despite some setbacks. In some cases NASA personnel occupied buildings within one year after the beginning date of construction. Each building had a basic steel frame skeleton with

[34] Shields interview, pp. 7-8; Wayne Blair to James H. Boykin, November 29, 1962, General Correspondence, 1505-11, Box 1664, FWD Storage.

[35] Ibid.

the exterior prefab concrete panels. As workers erected the steel frame, the panels were made off site. This practice enabled two basic stages of construction to occur simultaneously. Scaffolding was reduced. Consequently each building was "dried-in" quickly, that is, each was enclosed, allowing the tedious inside work to begin sooner.[36]

NASA and the FWD had developed a 4′ x 8′ modular concept that proved quite beneficial. The floor plan in each office building was arranged to accommodate 4′ x 8′ desk areas with full facilities—ventilation, lighting and communications. Hence temporary partitions were easily installed or removed according to the tenants' needs. This technique reduced the requirement for utility installations as the office arrangements changed after occupancy. After a decade of building use, NASA personnel said the modular plan was convenient and efficient.[37]

NASA benefitted from the FWD's experience with incremental funding. This method of funding referred to the congressional habit of appropriating funds for projects year by year, a common practice in the construction of reservoirs. In other words the District awarded contracts for future construction before Congress had appropriated the money. Frequently the FWD, like other districts in the United States, built a spillway one year and as congressional funds were appropriated, it started work on the dam the next year. The Corps' experience with incremental funding had been a major reason why NASA looked to it for help.

NASA expected to win congressional approval for more buildings at the JSC. The FWD designed and constructed the cooling and heating plant, for example, to accommodate future expansion. "We added a boiler, a chiller, or compressor, or what have you," stated Leo Zbanek. "We would take the end wall and move it fifty feet. We did this five times."[38] Though inefficient and costly in one respect, this method actually reduced cost and saved major redesigning at a later date.

One constant chore was to resolve the inspection standards employed by the two agencies. Because of its experience with intricate and delicate machinery, NASA followed high inspection

[36] Ballard interview, pp. 1-2; Koisch interview, p. 3.
[37] Conger to Brown, August 3, 1977.
[38] Zbanek interview, p. 36.

standards, not permitting dust, soil and other debris to accumulate on instruments or in work areas. The new agency wanted to incorporate aircraft industry inspection standards at the Center, but the FWD used the traditional brick and mortar standards. For the latter aircraft standards were not appropriate for building construction. At any rate agreements over the subject had to be reached throughout the Corps' five years of work at Clear Lake.[39]

Most perplexing for both parties, however, were the change orders. As the structures at the site took form, NASA personnel sometimes disliked what they saw. They had developed new technology requiring alterations in the construction. From the standpoint of NASA, the "customer," these modifications were essential to the space program and therefore reasonable. For the FWD they were troublesome. Change orders slowed work and increased costs. Construction firms wanted compensation, but NASA, according to its policy on contingency funding, was slow to approve such claims. The FWD insisted, however, that compensation for such work was reasonable, and since it was the contracting agent, the District had to handle the disputes with the firms. During the five years of the District's involvement at the JSC, NASA filed 1500 change orders. No other facet of the project was as difficult for both parties as the change orders.[40]

Compounding the FWD's frustration was NASA's practice of dealing directly with the construction company for these changes instead of following procedures. Colonel Koisch persuaded them to process modifications through NASA's own Facilities Division headed by Leo Zbanek. But Zbanek, an employee of NASA, tended to agree that the requests were necessary. Though the FWD wanted to suit the "customer," it tried to meet the deadlines and hold down costs. "The constant interference of the actual user," Koisch stated, "was a headache."[41]

Each agency could justify its position, and the conflict was unavoidable. President Kennedy had set a deadline on the space program when he called for a man on the moon "by the end of the decade." The technology for such a feat was undeveloped, however, and NASA had to grope its way through the Apollo

[39] Ballard interview, p. 7.
[40] Koisch interview, p. 4.
[41] Ibid.

mission step by step. Though it wanted space accomplishments, Congress by 1963 had lost some of its enthusiasm for funding NASA's projects. Budgetary limitations, therefore, required all parties to be alert for increased costs. The numerous change orders, dictated by advancements in technology, drove up costs, and since the FWD shouldered the responsibility to build the Center, it had to hold modifications to a minimum. The two parties should be commended for their spirit of cooperation because the construction companies filed a relatively small number of claims for 137 contracts on such complicated work. The daily meetings of FWD and NASA personnel at the site partly accounted for the overall accomplishment at the Center under the burdensome conditions.[42]

Four basic buildings remained, and each was treated as a separate component because of the complexity of its design and purpose. They were the Mission Control Center (MCC), the Anechoic Chamber, the centrifuge building and the structure to house environmental chambers A and B. The MCC was not in the original master plan because Congress had not approved it. "It was inserted into the master plan about 10 o'clock," according to one NASA official.[43] The new building fit into the JSC easily owing to the flexibility of the design concept. The practice of increment building also eased the addition of the MCC, and therein lay much of the significant contribution of the FWD.

The construction of the MCC was impeded by the changes in design dictated by advances in technology. As scientists and engineers designed and built the sophisticated equipment to be housed in the MCC, specifications on the building had to be changed. The A-E firms, wrote one observer, "faced the almost impossible task of designing a facility to accommodate equipment which also had not been designed."[44] NASA decided to install pneumatic tubes in the MCC to transport written messages and scientific drawings among offices as quickly as possible. During an orbital or lunar flight, time was vital and each step of the astronauts' routine was set on a precise timetable. Strict adherence was essential, especially in the event of a

[42] Shields to Brown, July 29, 1977; *Fortune*, LXVIII (November, 1963), 125-128.

[43] Zbanek interview, p. 34; Senate, Committee on Aeronautical and Space Sciences, *Hearing on S. 1245, Authorization for Fiscal Year 1964*, 88th Congress, 1st Session, June 12, 13, 17 and 18, 1963, pt. 2, pp. 837-838.

[44] Ballard interview, p. 6.

mechanical failure in outer space. Accidents or malfunctions would have to be corrected immediately at the Center. NASA personnel concluded, therefore, that the pneumatic tubes would save precious time. But they ordered the installation of the tubing after the concrete walls and floors had been poured. The FWD thereupon had to instruct the respective construction company to tear out the utility wiring tunnels and install the pneumatic tubes. The extra cost was known as the contingency funding, and NASA's policy was to withhold a major portion of that funding to enable the JSC Financial Management Division to examine the need and acceptability of all requests for compensation. Contracting companies affected by these change orders complained bitterly to the FWD.[45] Despite the delays, progress was rapid and NASA occupied the office portion of the MCC in February, 1964.

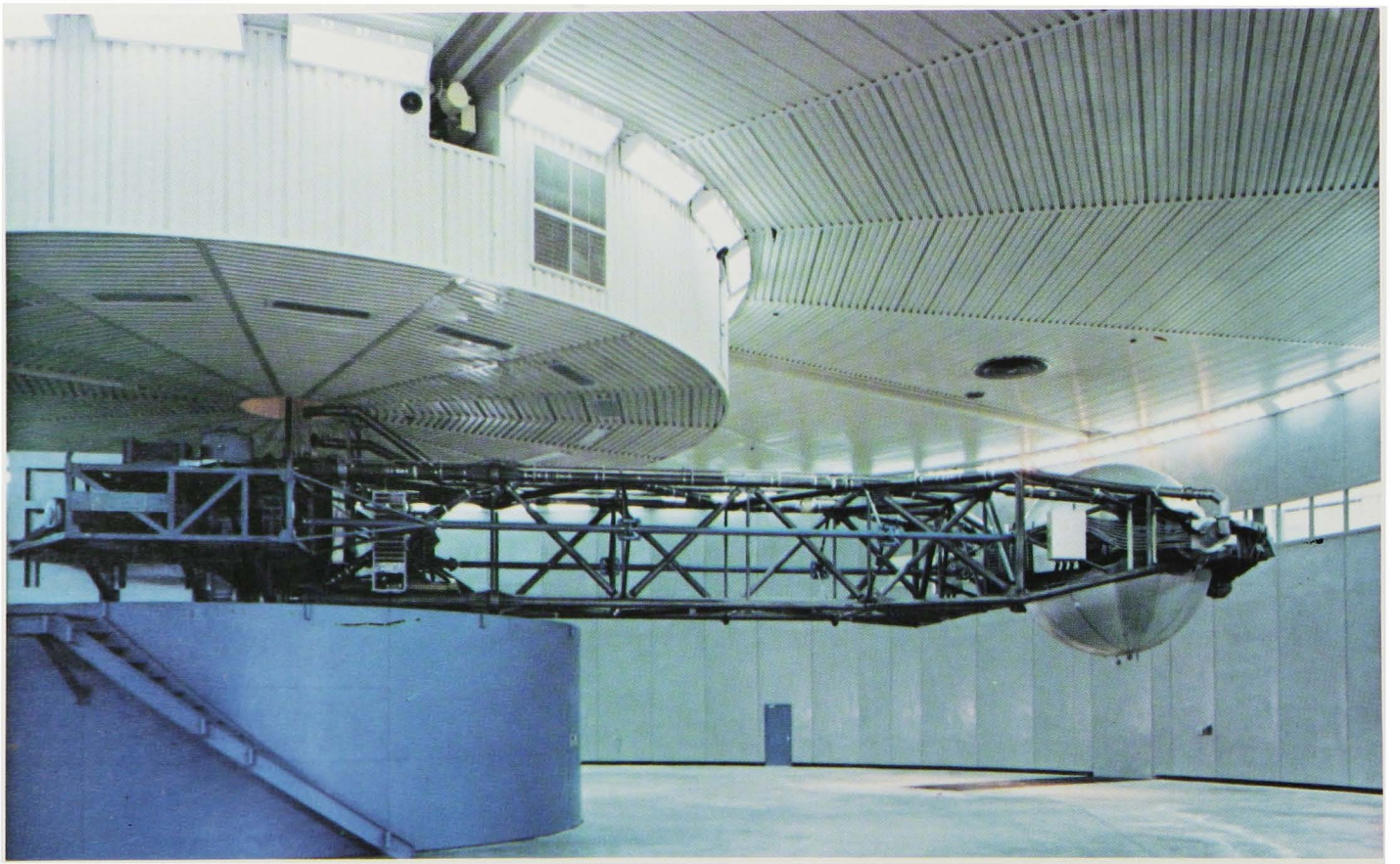
The policy of the Corps of Engineers was to incorporate contingency funding estimates prior to the award of the contract. Colonel West had made exceptions for the sake of NASA, but he had strongly recommended in October, 1962, to Brigadier General C. H. Dunn at the Southwestern Division that arrangements be made for NASA to change its policy and conform with regular practices. Throughout the construction period this procedural difference persisted, and some contractors filed claims for compensation. As the contracting agent, the FWD had to settle the claims.[46]

Conflicting policies over contingency funding demonstrated the communication gap between NASA and the FWD. The former was a new agency with no clearcut guidelines or directives established. In the case of the FWD, however, policies and procedures were well known and based on years of experience. NASA was not, furthermore, experienced or accustomed to meeting deadlines. Space research was haphazard, based on trial and error. Work proceeded until a solution was found. Engineers in the Corps had long operated with precise deadlines, and each District took pride in meeting them. "The Corps people were anxious to adhere to established schedules," according to one assessment, but the scientists wanted a flexible approach because

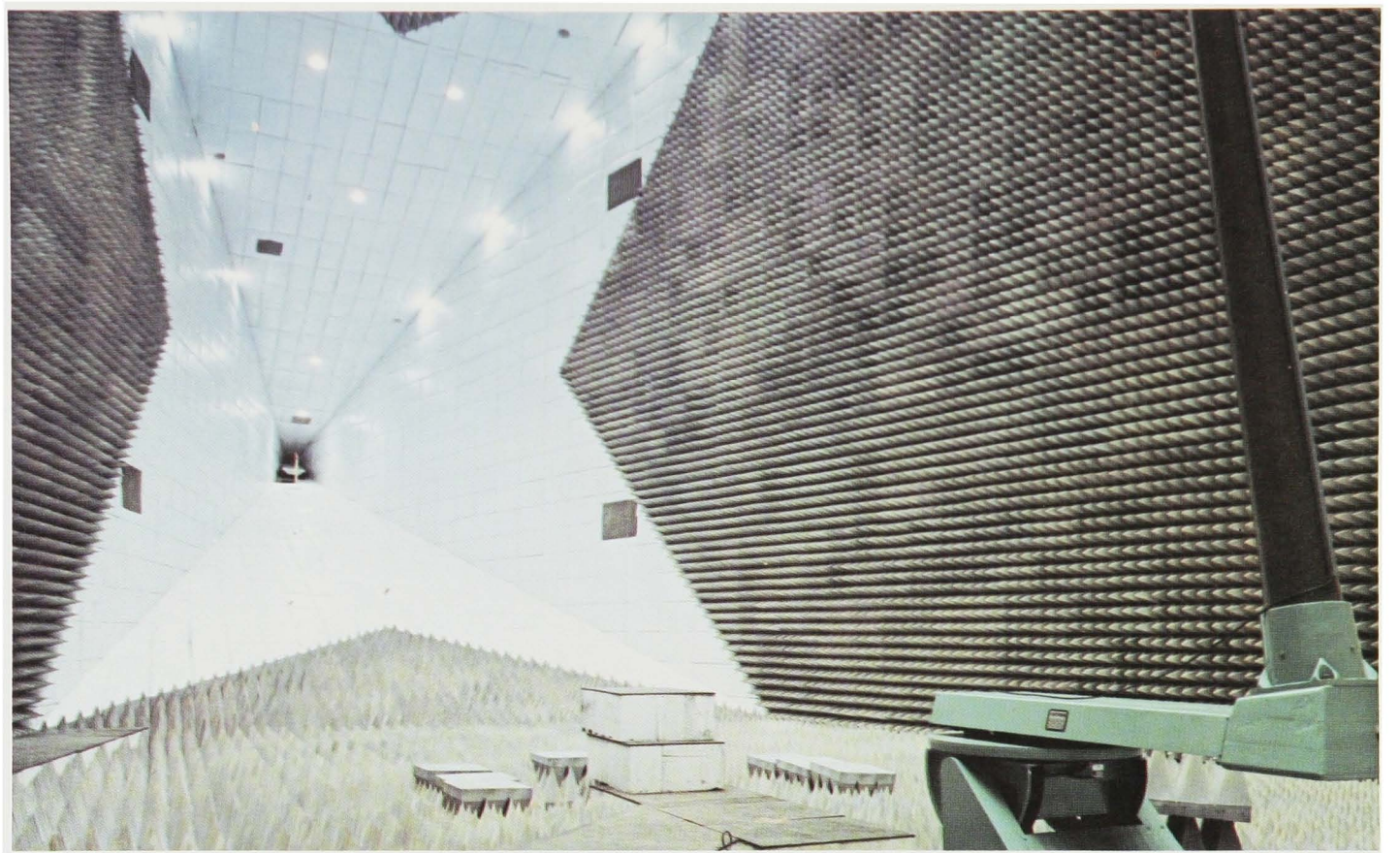
[45] Shields to Brown, July 29, 1977; Conger to Brown, August 3, 1977.

[46] R. P. West to C. H. Dunn, October 22, 1962, General Correspondence, Box 1664, FWD Storage.

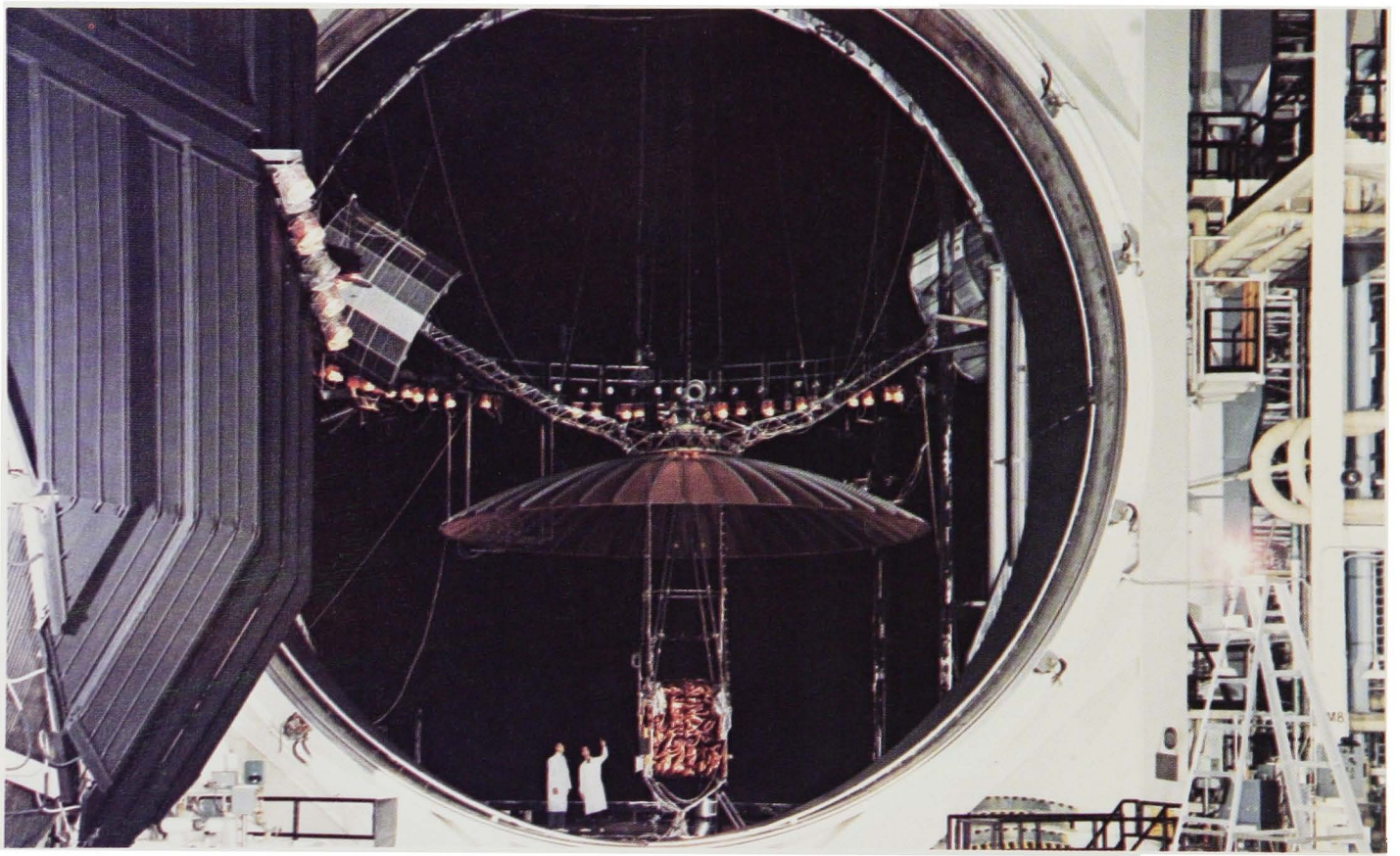
Mission Control Center, Johnson Space Center, Houston, Texas. (NASA photograph)



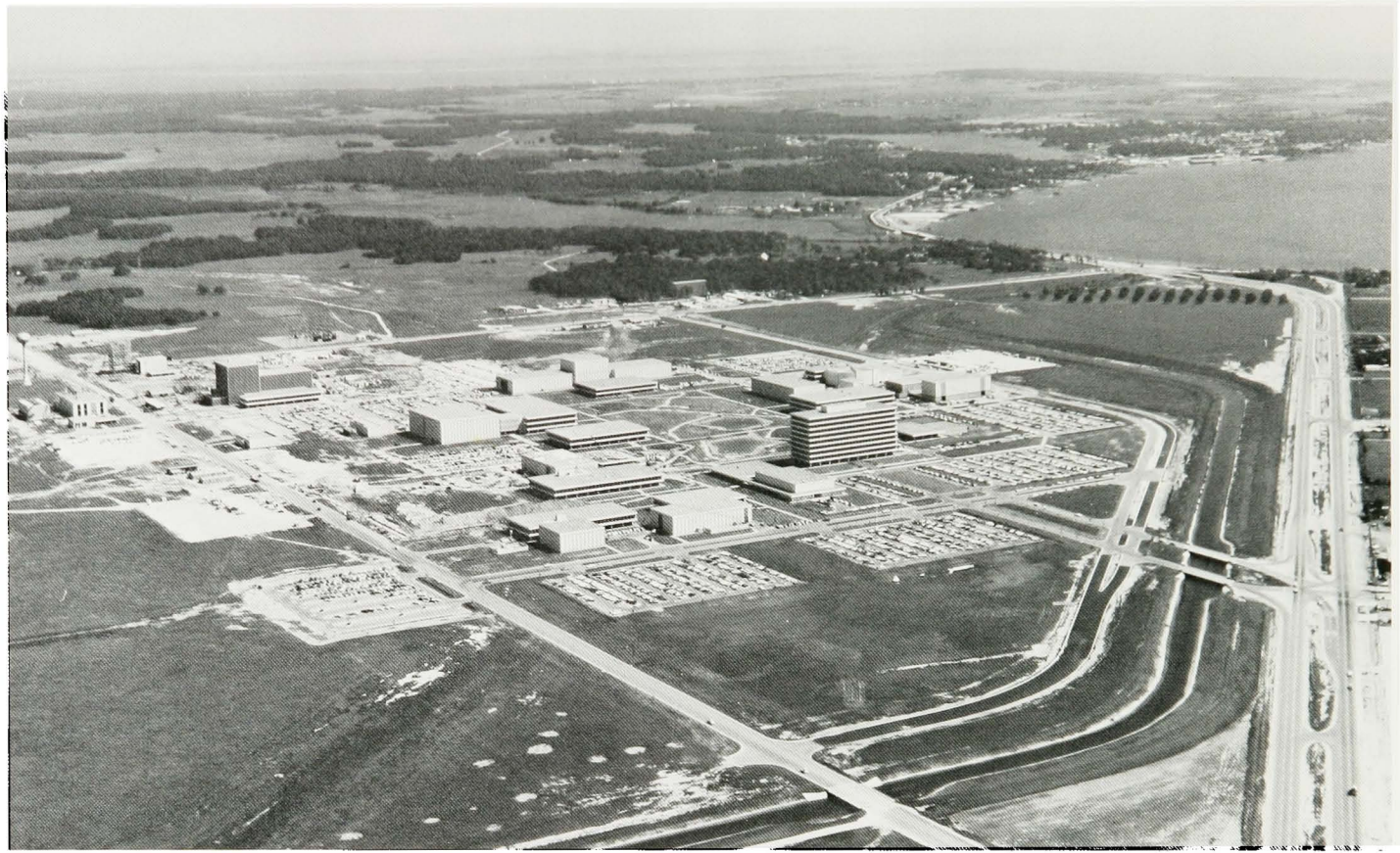
The Centrifuge, a three-man gondola, Johnson Space Center. (NASA photograph)



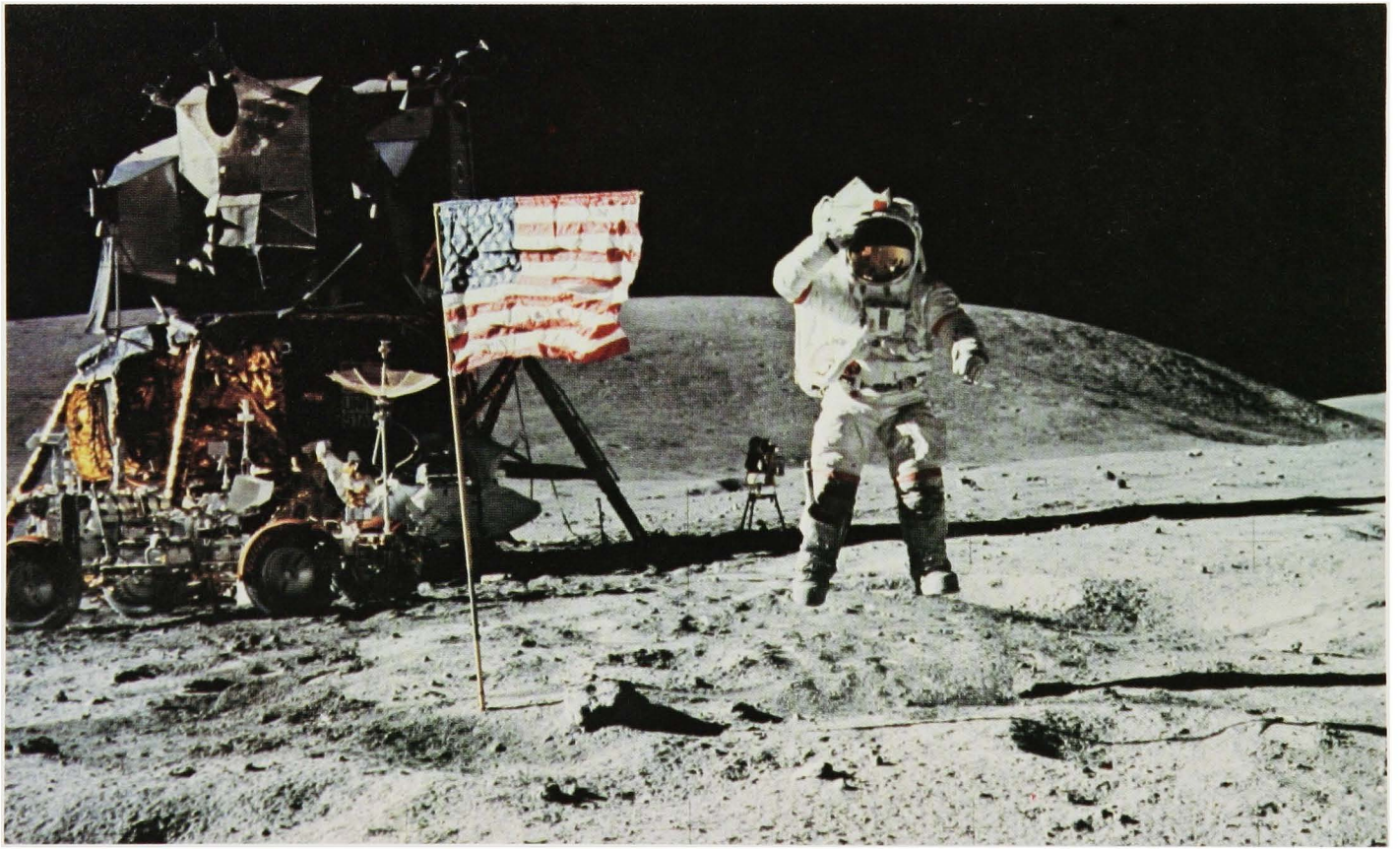
The Anechoic Chamber, "You can hear your own heart beat." (NASA photograph)



Environmental Test Chamber A, advancing the state of the art of space science. (NASA photograph)



Aerial view of Johnson Space Center, September, 1964. (NASA photograph)



Mission accomplished. (NASA photograph)

of the experimental nature in defining the purposes and functions of the buildings.[47] Part of the problem was, therefore, the mentality of the engineer in conflict with that of the experimental scientist. On the subject of contingency funding, however, NASA was ironically the inflexible partner.

The building to house the centrifuge, the Flight Accelerations Facility, Building No. 29, provided no serious problems. It was designed by Ford, Bacon and Davis and was constructed under Phase IV. The actual building was finished in December, 1964. A real handicap developed with the centrifuge, for the vacuum pressured gondola which carried the astronauts failed during a manufacturer's test at Lockheed's plant in Ontario, California, on September 23, 1964. The round sphere-like structure imploded during a trial vacuum "pump down." Specifically the cap containing the hatch imploded, and according to Brigadier General R. H. Free, Southwestern Division Engineer, "debris from the imploded cap struck the inner surface of the opposite cap, causing sufficient damage to render it useless." Two days later FWD engineers and NASA personnel met with the manufacturer at Ontario, and the Rucker firm assured them that it could repair the gondola and deliver a satisfactory product. Remedial measures were taken, and during the week of December 14, 1964, the gondola passed all tests.[48]

But the next month a failure occurred in the gimbal ring, the circular device that held the gondola in place. It was fabricated in the Baltimore plant of the Martin-Marietta Corporation. The gimbal ring failure meant that the FWD and NASA could not meet their deadline date of March 5, 1965, to have the centrifuge ready for use. This brought approximately one year delay in the actual use of the centrifuge because the manufacturer had to make a complete structural reanalysis. Little was known at the time about the welding characteristics of the stainless steel used in the gondola. The extra cost for the redesign came to $800,000. As was the case with the gondola, the FWD was the contracting agent and, therefore, had to protect the interests of NASA in the repair of the gimbal ring.[49]

No serious difficulties or delays arose with the construction of

[47] Merrifield, "MSC Narrative History," p. 17.

[48] R. H. Free to W. K. Wilson, April 16, 1965, General Correspondence, Box 1664, FWD Storage.

[49] Merrifield, "MSC Narrative History," p. 14.

the Anechoic Chamber and the Thermochemical Test Facility. Both were sophisticated structures, but did not push the state of the art as much as the centrifuge. To the average citizen the Anechoic Chamber was one of JSC's most impressive sights. Its purpose, according to one writer, was "to simulate free space and enable designers to test electronic communications gear without the interference of earth-originated electromagnetic emissions."[50] It was a gigantic room resembling an aircraft hangar and shaped like a horn with the walls and ceiling lined with pointed rubber cones. A forty-six acre antenna range was adjacent to the Chamber.

At one point both the FWD and NASA engineers became convinced that the Chamber would not withstand the test pressures and vacuums. Failure of the centrifuge had made them cautious and apprehensive about the other exotic facilities at the JSC. To convince them of the soundness of the design the contractor built a ¼ scale model and tested it. The contractor placed excessive pressure on the model, and it withstood the strain. "These tests convinced both the JSC and the Corps people," reported one observer, "that the contractor's design was sound."[51] The Anechoic Chamber was finished in 1965, and so quiet was the device that the astronauts reported they could hear their own heartbeat inside the chamber.

For the FWD the Space Environment Simulation Chamber A was the most taxing project of the Center. To begin with, NASA had proceeded to select the A-E firm for the Chamber independently of the FWD. The latter discouraged this practice until NASA agreed to proceed jointly with the Corps in selecting the A-E. The Bechtel Corporation received the prime contract, but subcontracted the device to Chicago Bridge and Iron. The FWD awarded a separate contract for the building to house Chamber A. Erection of Building No. 32 was no ordinary feat, for it also was a highly technical structure. The District established a special project office for it alone.[52]

Construction of the Chamber and the building progressed smoothly until Chicago Bridge and Iron conducted its first vacuum test of the five-story Chamber. It was already installed in Building No. 32, its home. After five hours of the "pump down,"

[50] Ibid., p. 15.

[51] Ibid., p. 17.

[52] Shields to Brown, July 29, 1977.

engineers began to hear creaking noises, but the manufacturer assured them nothing was wrong. The pump down continued. As the test neared the required maximum vacuum, a sound similar to a rifle shot came out of the Chamber. NASA stopped the test. The area around the large door, forty feet in diameter, had begun to crumble. Specifically the metal sheathing around the door failed for lack of reinforcement. Damage was too severe for quick repair. Massive redesign and construction would be necessary. Cause of the implosion was a computational error by an executive at Chicago Bridge and Iron.[53]

In one respect the FWD had to share the responsibility for the failure. Colonel Koisch had ruled against the usual procedure of having an inspector observe the construction of the Chamber for reasons of economy and public relations. Koisch had no one on his staff technically capable to inspect the work, and "he doubted that it would be prudent and reasonable," stated one writer, "to hire a competitor of Bechtel to check Bechtel's work."[54]

Failure of the Chamber also required some revaluation of Building No. 32 which was about one-third complete when the test occurred. NASA, therefore, presented the FWD with numerous change orders on the building. NASA even halted construction of the building until the difficulties of the Chamber were clarified. But the building contractor complained of the costly delay and demanded compensation. The FWD was definitely at a disadvantage and had to negotiate the claims under trying conditions. NASA's Facilities Division later concluded that it should have arranged at that point to obtain a new company to finish the building.[55]

Work resumed on the building, though it progressed slowly owing to the change orders. The District hired special consultants to observe the reconstruction of Chamber A. Toward the end of 1965 the Chamber was finished and given final approval for use.[56]

But the FWD undertook to regain some of the losses incurred with Chamber A. Through the Department of Justice the FWD filed suit against the Bechtel Corporation. The Department of

[53] Merrifield, "MSC Narrative History," p. 6.

[54] Ibid., p. 7.

[55] Zbanek interview, p. 14; Shields interview, p. 7.

[56] Freeman to Wilson, April 16, 1965. Chamber A also presented problems with regard to the sun simulators and the rotating lunar plane. For a fuller discussion, see Merrifield, "MSC Narrative History," pp. 9-13.

Justice did not file the case until 1971. Six years later the case was resolved in favor of the FWD. Bechtel agreed to make a compensatory payment to the United States Treasury for $1,750,000.[57]

As the JSC took form, NASA personnel occupied the buildings. By June, 1964, the Facilities Division assumed the responsibility for maintenance of the Center and needed a wide range of equipment: fire trucks, maintenance vehicles, lawnmowers, grass seeders and similar grounds-keeping machinery. At the same time NASA had about $2,000,000 to spend by June 30, or lose it. The new agency asked the FWD to handle this procurement on short notice. It was a sizable task to accomplish in thirty days, but the District agreed. The deadline was met, no small accomplishment since the job included writing equipment descriptions as well as observing the procedures governed by federal regulations.[58]

In November, 1966, the FWD ended its operations at Clear Lake. For some members of the District the end probably came as a relief from the general nature of the space program—the fast pace, the budget limitations and the experimental character of the work that made each decision untenable. Personnel worked much overtime; a six day week at ten to twelve hours per day was routine. Hence the staff in both agencies spent less time than normal with their families—a likely cause of irritation.[59]

The JSC was also caught in the maelstrom of world politics. Originally the commitment to a lunar landing was based on the need to reassert American superiority in science and technology. The program also had military ramifications, though they were ambiguous. Toward the end of 1963, however, the tension between the United States and Soviet Union had eased, and Washington officialdom began to reassess the space program. This international development did not reverse the commitment of the President or Congress toward space research, but it did introduce a sense of caution and a questionable regard for NASA's budget requests. Within the scientific community there was also some question of the value of a lunar landing. Better to move slower and develop a more diversified technology, so the critics insisted, than rush to the moon. For the parties involved at

[57] Aubrey Burkett to D. Clayton Brown, July 29, 1977.

[58] Koisch interview, pp. 9-10.

[59] Lechter to Brown, July 28, 1977.

the JSC, this change of attitude at the highest levels of government meant an even greater need to hold down costs and to finish their work before further erosion of the space program could occur. In such an atmosphere disagreements over construction matters of such an advanced state were almost inevitable.[60]

Several valuable lessons were gained in the construction of the JSC. Koisch concluded that a three stage process of conception, design and construction with a minimum number of firms involved would have reduced confusion. He also thought the maintenance of a separate engineering staff on the job site was an advantage and recommended that procedure for future tasks of similar magnitude. Field engineer Jack Shields urged the use of cost-plus incentive fee contracts for future jobs of similar nature. Chief Engineer James Ballard agreed. It would help, Shields added, to establish clear lines of communication as soon as possible not only between agencies but also among District employees.[61]

The predominant theme had been cooperation and not conflict. Principal figures of both the FWD and NASA expressed the highest regard for one another. "We could not have built these facilities," Zbanek commented, "without the assistance of the Corps."[62] NASA Administrator Webb added: "They did a magnificent job."[63] In regard to the Facilities Division Colonel Koisch said, "it did an exceedingly fine job."[64]

Probably the greatest tribute to both agencies was the final product. The JSC was an attractive site with architectural lines pleasing to the eye. It was not ostentatious, but efficient and commanded respect from the public. It was a great contrast to the debris-ridden 1600 acres that greeted visitors after the onslaught of Carla. Indeed the whole Clear Lake area was transformed from a grassy lowland to a bustling community. One employee summarized the feeling of the FWD when he said, "the Corps is very proud of the facility at JSC."[65]

[60] *Fortune*, (November, 1963), 125-128.

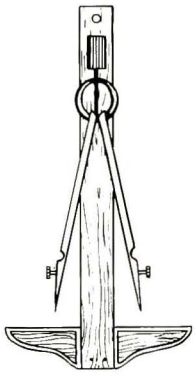
[61] Ballard interview, p. 2; Shields interview, pp. 4, 10; Koisch interview, pp. 5, 10-11.

[62] Zbanek interview, p. 2.

[63] Merrifield, "MSC Narrative History," p. 30.

[64] Koisch interview, p. 7.

[65] Quote in Ballard interview, p. 8; David Lang, "The Impact of the Manned Spacecraft Center on the Houston-Gulf Coast Area," typescript MSC-PAO (July, 1967).



CHAPTER V

The Battle of the Trinity

The most controversial project identified with the FWD was the proposed Trinity River canal. Navigation of the Trinity, winding over 500 miles from Fort Worth to the Gulf of Mexico, was a dream of the settlers as soon as they reached the area in 1841. From the beginning, however, the Trinity had several handicaps as a canal—the most serious was the shortage of water. Promoters proposed schemes varying from efforts by entrepreneurs with small steamboats to a full-scale campaign to obtain federal construction of a canal replete with locks and dams. The Corps of Engineers made several studies of the navigability of the stream and at the turn of the century built some locks and dams. A negative Corps report at the end of World War I, plus competition from the railroads, set the canal back. But the idea was revived and led to a stiff contest between the canal's sponsors and environmentalists in the 1970's.

Dreams of a navigable Trinity went as far back as 1833 when the Mexican State of Coahuila-Texas granted District Commissioner Francisco Madero the right to introduce vessels on the stream "propelled by steam or horsepower, sails or oars upon the Trinity River."[1] Madero had exclusive right to the river for eighteen years, but the outbreak of the Texas Revolution in 1835 forced him to drop his plans.

[1] Gene A. Barbee, "Review of Historical Documentation Related to the Early Commerce on the Trinity River and Tributaries," *Navigability Study: Trinity River, Tributaries (River Mile 182.7 to 715.0)*, (April, 1975), Fort Worth District, Exhibit 14, p. 2.

Records indicated that the first steamboat to traverse the Trinity was the *Scioto Belle* in 1836. There was nothing to show how far up the river she went. In 1842 the *Ellen Frankland* steamed about 400 miles up the Trinity, and the captain reported that navigation was possible to within sixty miles of the Red River. Some traffic also existed on the lower portion of the Trinity. These instances of successful navigation on the upper stretches were unusual and probably occurred when spring rains swelled the river because no systematic or dependable traffic was established.[2]

The push for a navigable Trinity began with the first settlers in north Texas. In 1841 John Neely Bryan, founder of the city of Dallas, staked his claim at the spot where the three forks of the river converge. Five years later he surveyed the site and proceeded to sell lots. A steady stream of settlers followed, and they discovered that cotton and wheat would grow on the rolling prairie. As was the case throughout Texas, the lack of transportation was a real handicap to further growth of the area. Ox wagons were the only means of transporting freight, but at the price of twenty cents per ton mile, the small band of farmers could not compete. It was only natural for them to regard the Trinity, which opened on the Gulf, as the solution. The same need for transportation plagued settlers on the Brazos and Red.[3]

In 1852 a band of Bryan's friends built a small flatboat, *The Dallas,* to haul cotton to Porter's Bluff near Corsicana, about seventy miles down the river. Loaded with twenty-two bales and using poles for power, Adam Haught guided the vessel downstream. Four months later he reached his destination, repeatedly delayed by snags, overhanging branches and "rafts." From that point he finished his journey to Houston by wagon. His length of time to travel such a short distance made navigation of the Trinity impractical at the northern end. Traffic between Anahuac and Liberty, about forty miles up the river, was routine, but navigation beyond that point was hazardous and questionable.[4]

As the population in north Texas increased, navigation of the Trinity became more important, and the hope for regular traffic

[2] Robert E. Mills, "Navigation of the Trinity River," (unpublished Masters thesis, Sam Houston State Teachers College, 1943), pp. 11-13.

[3] John William Rogers, *The Lusty Texans of Dallas* (New York, 1951), 36-38, 111-112.

[4] Ibid.

on the stream persisted. In 1852 Congress instructed the Corps of Engineers to survey the river for navigation. They reported that only limited use, meaning small vessels during the high water season, was feasible. Two years later the *Mary Clifton,* loaded with 2500 bales of cotton, came within forty miles of Dallas, and in 1868 *Job Boat No. 1,* rated at twenty-six tons, reached Dallas. But the *Job Boat* required over a year to make its trip; crewmen had to clear a path through numerous snags and rafts. Voyages were only possible during high water in the spring, for as one Dallas citizen reported in 1870, "rates for hauling to the depots [are] exhorbitantly high, [and] a large portion of the cotton will have to wait for a turn in prices, or a spring rise in the river."[5]

The success of the *Job Boat,* nonetheless, stirred excitement, and Dallas businessmen arranged to build a larger steamboat, the *Sallie Haynes.* Eighty-seven feet long and eighteen feet across at the beam, she was christened in 1868. The *Sallie Haynes* made several trips to Magnolia located about half the distance to the Gulf, but succumbed to a snag below Dallas and sank. But interest in the Trinity had already begun to wane with the possibility of a railroad reaching Dallas. In 1872 the Houston and Texas Central reached the city among much fanfare and rejoicing. Railroads were suddenly regarded as the answer to the problem of transportation. "It was a day never to be forgotten," wrote one spectator. "We're not only on the map but we're on the railroad now. Hurray for Dallas."[6]

As Dallas sought to overcome its transportation difficulties, another important event occurred in the history of the Trinity canal project—the founding of Fort Worth. In 1849 the United States Army established a post on a bluff overlooking the Trinity at a spot close to the present site of the Tarrant County courthouse. Protection from Indians was the purpose of the Fort. In a short time the line of the frontier moved farther west, and the Fort was abandoned. Settlers quickly occupied the vacant buildings, so that by 1860 some 200 civilians were permanently settled in Fort Worth, named after Major W. J. Worth.[7]

[5] Quoted in Mills, "Navigation of the Trinity River," p. 15

[6] Quoted in Rogers, *The Lusty Texans of Dallas,* pp. 117-118.

[7] Oliver Knight, *Fort Worth, Outpost on the Trinity,* (Norman, Oklahoma, 1953), 3-25; Robert H. Talbert, *Cowtown Metropolis: Case Study of a City's Growth and Structure* (Fort Worth, 1956), 1.

Land hungry families migrated to the site, and in 1872 the place was incorporated. Families continued to come, and since Dallas was only thirty miles east, a strong rivalry soon broke out over new settlers and businesses. The rivalry would frequently reach a high pitch during the next 100 years, but the two competitors later joined forces in one respect—they agreed to fight for channelization of the Trinity, and Fort Worth became the desired uppermost point of navigation for the canal promoters.

Until the close of World War I Fort Worth played no part in the project, and Dallas remained the prime mover for a Trinity canal. The city came close to its dream with the Trinity River Navigation Company organized in 1891. It was not a fledging company hoping to make quick profits with a few voyages, but committed to improvement of the river for navigation. After raising $62,500, the firm built a "snag puller," the *Dallas,* and purchased a steamboat, the *S. S. J. H. Harvey, Jr.* Steaming behind the *Dallas,* the *Harvey* completed a voyage from Galveston to Dallas in 1893. But the Trinity remained indefatigable, and the company, unable to make more voyages, had to sell the *Harvey* in 1898 to a firm operating in Louisiana.[8]

The Trinity had two serious drawbacks for navigation: (1) it was constantly filling with snags and logjams, and (2) it did not have enough water. Two early reports by Army engineers reinforced these points. In the survey Congress authorized in 1852, Lieutenant H. C. Whiting reported that steamboat traffic had occurred on the river, but only during springtime. When the water level was high, navigation was feasible for about 600 miles above the mouth. For the rest of the year navigation was impossible.

A second survey finished in 1891 also indicated the Trinity's shortcomings. Major Charles J. Allen reported that too many snags obstructed the river between Magnolia (Anderson County) and Dallas. The same condition applied to that portion of the river below Magnolia. Because of the advent of railroads, Allen did not think the volume of business would warrant the cost of even another survey.[9]

[8] E. H. Brown, *Trinity River Canalization* (Dallas, 1930), 41; Rogers, *The Lusty Texans of Dallas,* pp. 128-129.

[9] Mills, "Navigation of the Trinity River," pp. 20-25.

Such evidence did not deter the Dallas promoters. The same year Allen filed his report the Navigation Company sent a delegation to Washington in order to obtain federal assistance. Congress appropriated $7,000 for a preliminary survey of the river in 1899. Specifications of the survey called for the Trinity to be divided into four sections with separate estimates of improvement cost for each. Engineers were also instructed to file estimates of the cost of making each section navigable with the use of locks and dams at depths of four, five and six feet, respectively. Lieutenant Colonel C. J. Richie conducted the study, but the $7,000 appropriation was too small to allow a detailed report. To make the river navigable to Dallas at a depth of six feet, he reported, would require thirty-seven locks and dams at an estimated cost of $4,650,000.[10]

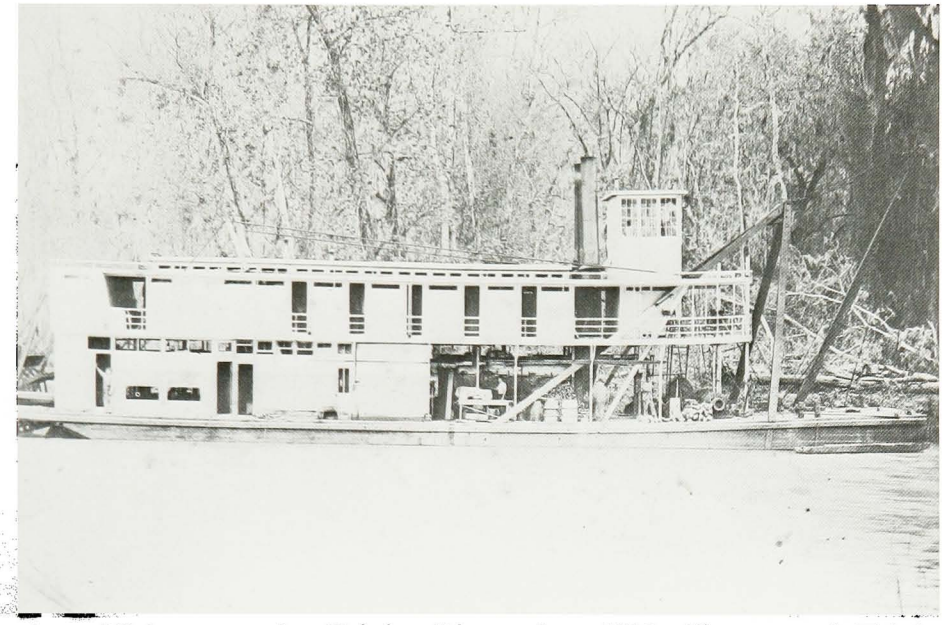
Unlike his predecessors Richie fully believed in the merit of a Trinity canal. He saw the river as a natural channel traversing 500 miles through fertile land that gained population each day. On the headwaters of the Trinity was a city with potential for industrial and manufacturing growth. Construction of a canal would enable Dallas to realize that potential. Richie's Division Engineer, Colonel Harvey M. Robert, emphatically agreed. He reported to the Chief of Engineers that "assuming it will effect a reduction in freight rates equal to one-tenth of what is claimed by the Dallas Commercial Club, the entire cost of the work, even for six-foot navigation, would be saved in less than three years."[11] He recommended construction of the locks and dams.

In 1902 Congress appropriated $125,000 for the Secretary of War to begin construction of the locks and dams. Funds were made available for purchase of a snagboat to clear the river of obstructions. Work began, and each year Congress appropriated funding for the project. In 1904 Texas Senator Charles A. Culberson pushed a bill through Congress to make the locks and dams larger so as to accommodate larger vessels and to permit more of them to pass through the locks at one time.

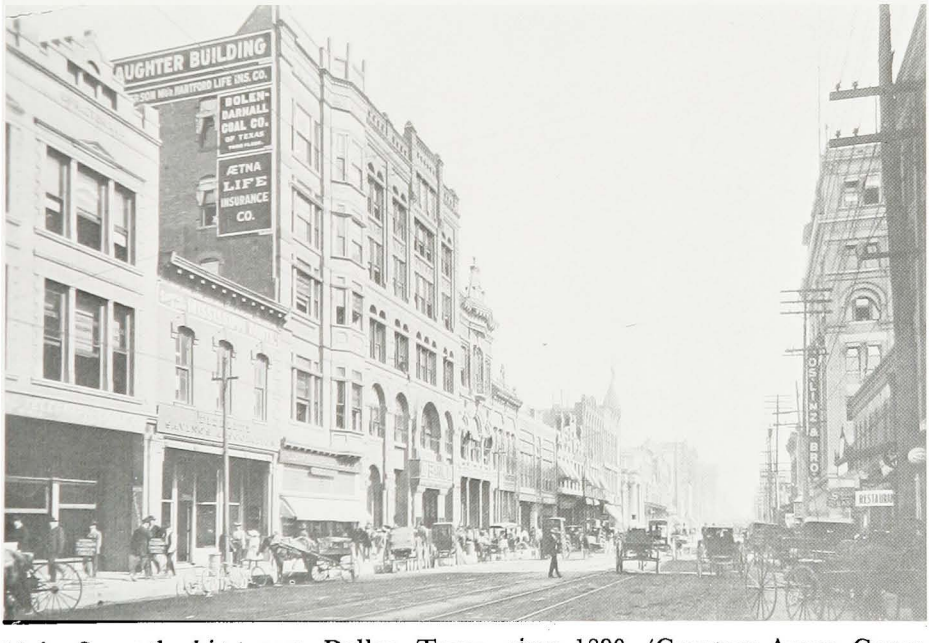
It seemed that the Trinity canal would become a reality. Congress continued to provide funding, the Corps of Engineers awarded contracts and as many as 170 men worked on the river at one time. Cost for each of the locks and dams ranged from

[10] Ibid., p. 27.

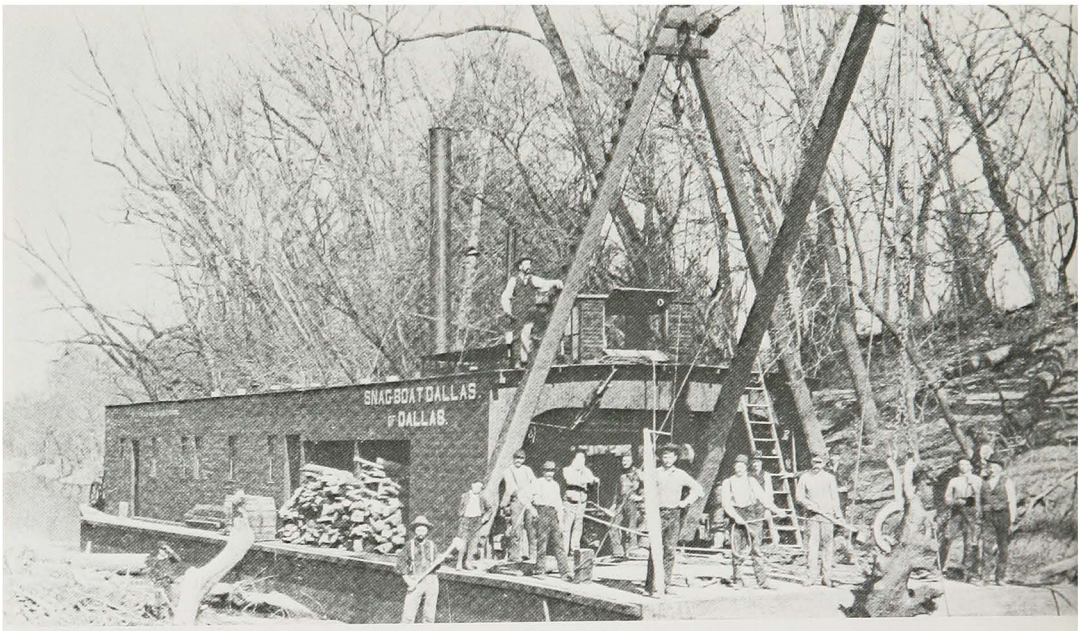
[11] Quoted in ibid., p. 28.



A paddleboat on the Trinity River, circa 1890. (Courtesy of Trinity Improvement Association)

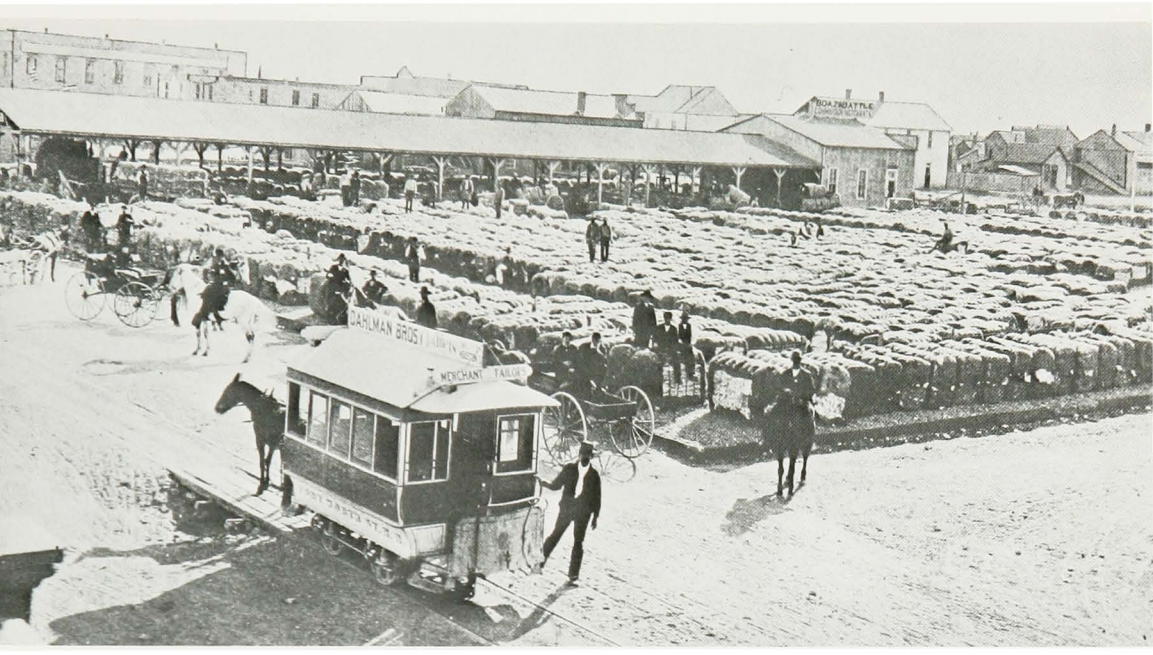


Main Street looking east, Dallas, Texas, circa 1890. (Courtesy Amon Carter Museum, Fort Worth, Texas)



Snagboat *Dallas* in operation.

Main Street looking south from the courthouse, Fort Worth, Texas. (Courtesy Amon Carter Museum, Fort Worth, Texas)



Cotton waiting to be shipped in front of Boaz and Battle Cotton Yard, Fort Worth, Texas, circa 1880. (Courtesy Amon Carter Museum, Fort Worth, Texas, from Collection Geneology and Local History Dept, Fort Worth Public Library)

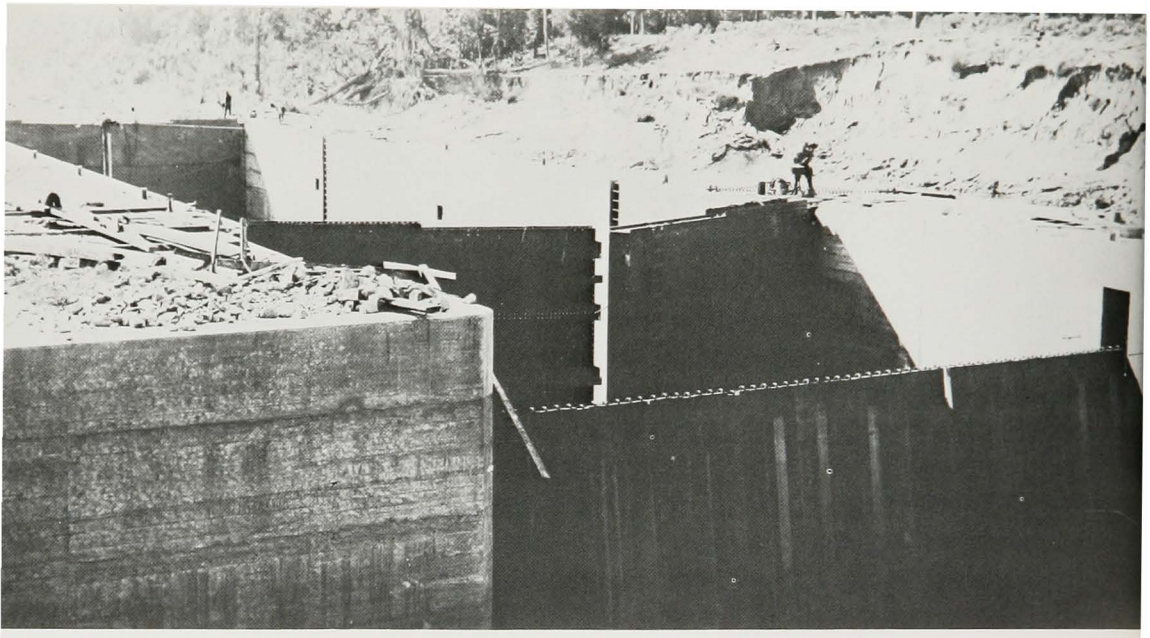
A log jam on the Trinity River, 1909.

Snagboat *Trinity* sunk February 13, 1910.

Shortage of water, the greatest handicap for a Trinity Canal. The Trinity River at low water.

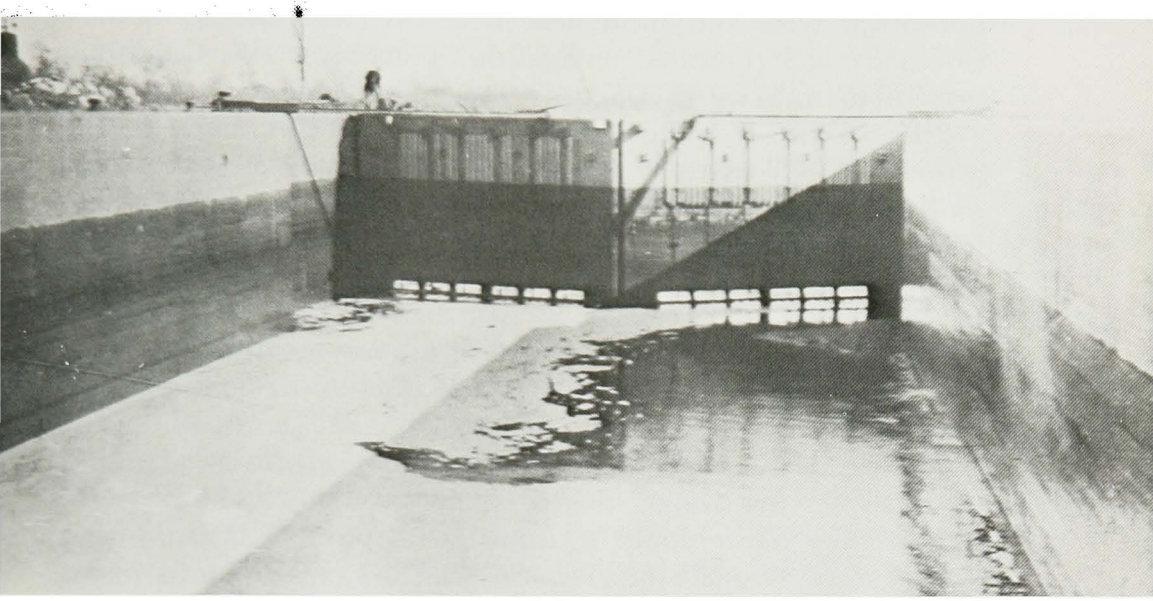
A work crew on the Trinity River, circa 1910.

Clearing a log jam on the Trinity River, circa 1910.

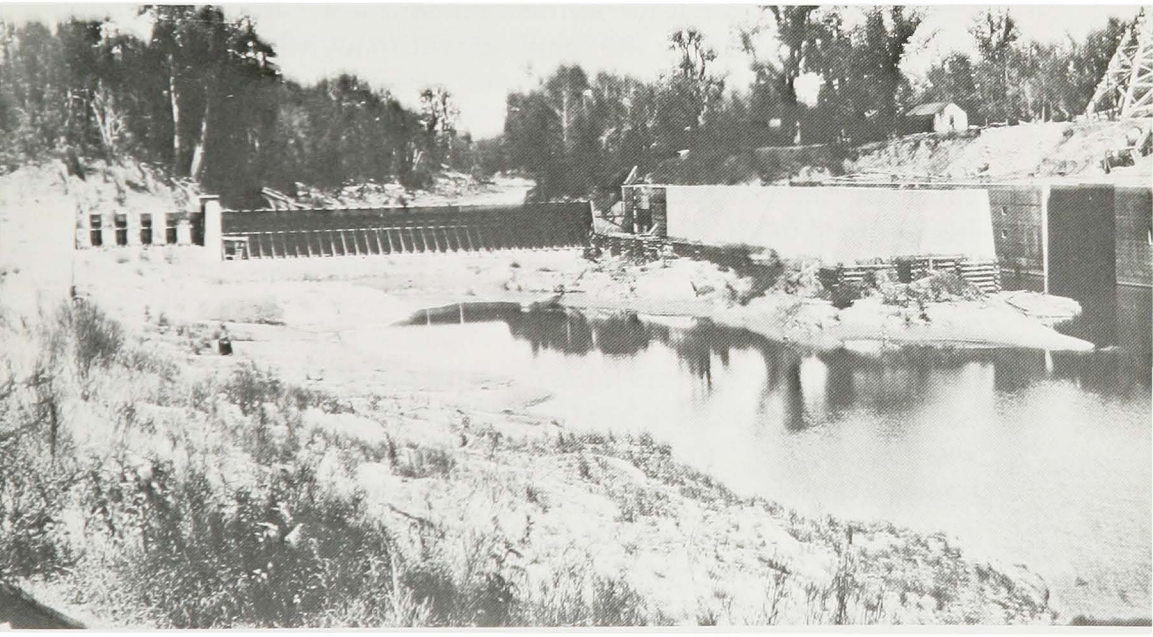


Lock under construction on the Trinity River, 1914.

Construction on the Trinity River, 1915.



Lock near completion on the Trinity River, 1916.



Dam and lock under construction on the Trinity River, 1916.

$155,000 to $200,000. Dallas business interests had contributed to the funding, mostly to increase the height of bridges that would have obstructed the passage of barges and steamboats. So optimistic were the promoters that in 1908 the Navigation Company had promised navigation of the river as a Christmas present to the city of Dallas.[12]

Enthusiasm for the project weakened, however, as the promoters were increasingly required to carry some of the costs, especially the raising of bridges. In 1909 the president of the Navigation Company, C. A. Keating, resigned, and according to one writer, "the company gradually relaxed its efforts to secure navigation of the river."[13] The firm had spent $162,343 on the project. Another reason for the loss of interest was the promise of a new railroad terminal in Dallas, a structure to be the largest building in Dallas up to that time.

Faced with the possibility of river traffic competition, the seven railroads serving Dallas pooled their resources and offered to build a massive terminal equipped with modern facilities and able to acccommodate much traffic. For the general population of Dallas the appeal of such a structure overshadowed the possibility of a canal. The latter, furthermore, was more expensive and required local funding, and despite the engineering reports, the feasibility of the canal for uninterrupted use remained uncertain. To kill any chances for the canal, the railroads asked to locate the terminal, Union Station, on the most strategic spot for a docking terminal, the small bluffs overlooking the Trinity. The railroads also asked for the right-of-way alongside the river near the bluffs. Thus, the natural riverfront was lost to competition because the city granted both requests. Suddenly the canal was dead.[14]

Continued federal involvement was the only hope for finishing the canal. By 1916 nine locks and dams were finished, but that same year the Corps of Engineers held a hearing in Dallas to determine if further expenditures were justified. Latest estimates had placed the price tag at $13,000,000. Completion of the project was expected to take fifteen years. "This hearing was really the handwriting on the wall" wrote one observer.[15] Dallas interests

[12] Ibid., p. 31.

[13] Ibid., p. 32.

[14] Floyd Durham, *The Trinity River Paradox: Flood and Famine* (Wichita Falls, Texas, 1976), 91.

[15] Brown, *Trinity River Canalization*, p. 53.

quickly formed another navigation company that same year, but it quickly died. The Chamber of Commerce formed one again in 1920, but despite their promotional efforts to stir enthusiasm, the Dallas citizenry was not interested.

The final blow came in 1921 when the Corps finished its study undertaken to determine the value of continuing the project. With the exception of the 41.4 miles below Liberty, navigation was not feasible, and "should not be attempted by the government."[16] Potential commerce did not warrant the canal, the engineers concluded, and the water supply was simply not sufficient. So severe was the shortage of water that during an earlier study the surveying party had abandoned its light quarter-boats and relied on land transportation.[17]

Much has been written about an article in the Dallas *Morning News*, October 1, 1935, purporting that a mistake by a member of Congress killed the project in 1921. According to Texas Senator Morris Sheppard, the Chairman of the House Rivers and Harbors Committee had promised to report the canal favorable despite the study by the Corps, but had mistakenly transposed the names of the Brazos and Trinity. When the bill was reported out by the Committee, the Trinity was omitted. Such an act seemed unlikely, however, because the Corps' report was on record, and the loss of local interest, always a critical factor in any water project, questioned the merit of further construction.[18]

Prospects for a canal were bleak. Although the seventeen counties in the river's watershed turned their attention to growth and expansion, the availability of fast rail service and the preoccupation with new motorized vehicles caused interest in the project to languish. Most of the promoters, such as C. A. Keating, had died or retired from active life.

For the rest of the decade the proposed canal received little attention. During that period, however, several developments occurred which encouraged the north Texas business interests to renew their fight. During World War I transportation was at a premium, and the need for a more efficient and coordinated

[16] Mills, "Navigation of the Trinity River," p. 34.

[17] T. H. Jackson, "The Trinity River Survey," *Professional Memoirs*, VII (July-August, 1915), 491.

[18] Dallas *Morning News*, October 1, 1935; Mills, "Navigation of the Trinity River," p. 35.

system of transportation became glaringly obvious. Marginal water transporters were brought into service to alleviate the pressure on railroads. Renewed interest in water transportation was, therefore, a by-product of the war. As a response to the need for adequate service, Congress passed the Transportation Act of 1920 in order "to foster and preserve in full vigor both rail and water transportation."[19] That measure committed the federal government in principle to projects such as the proposed Trinity canal.

Congress passed the Denison Act in 1925 to further stimulate canal transportation. As interpreted by one writer, the measure provided "that inland waterways may apply to the Interstate Commerce Commission (ICC) and obtain a certificate of public necessity and convenience, and the ICC shall direct all connecting common carriers and their connections to join with the inland waterway in the establishment of through rates and joint rates with reasonable rules, regulations and tariffs. The ICC is empowered to fix minimum differentials between all-rail routes and joint rates in connection with water routes. The differential amounts to approximately 20 percent in favor of the water route."[20]

If the Trinity canal were in operation, a shipment of grain from Amarillo to Atlanta would travel by rail to Fort Worth and be reloaded onto a barge. It would travel down the river, along the proposed intercoastal canal, up the Warrior River to Birmingham and be placed on another railroad. The law required railroads to cooperate with the water transporters, and the latter were entitled to a differential, or price advantage, of 20 percent calculated on an all-rail route to Atlanta. The Denison Act was obviously academic for the non-existent Trinity canal.[21]

As the cities of Fort Worth and Dallas grew in the 1920's, they expanded the municipal water supplies to keep pace with the burgeoning population. Fort Worth proceeded to build two sizable reservoirs—Eagle Mountain and Bridgeport. Lake Worth had been in operation since 1914. Dallas Power and Light Company planned to construct a lake in conjunction with an electric power plant. And Dallas planned to build a large

[19] Brown, *Trinity River Canalization*, p. 122.

[20] Ibid., p. 126.

[21] This example was taken from Brown, *Trinity River Canalization*, pp. 126-127.

reservoir—Lake Dallas. All were scheduled for completion in the 1930's.[22]

Another factor encouraging a new look at the proposed canal was the federal commitment to finish the Intercoastal Canal in its entirety by completing the portion from New Orleans to Corpus Christi. Congress took that step through the Rivers and Harbors Act of 1927. Canalization of the Trinity, which joins the Intercoastal Canal at Anahauc, would connect Texas with the Mississippi Valley by a total water route. Trade and commerce would logically expand in the Trinity watershed.[23]

These developments—the Denison Act, the federal commitment to an intercoastal canal and the construction of several reservoirs near Fort Worth and Dallas—changed the criteria by which the profitability and feasibility of the canal had been measured in the past. The Denison Act expanded the potential market area of the proposed canal, significantly increasing the tonnage expected to be shipped down the river. A real increase was likely because of the 20 percent differential available to the water transporters. The anticipated benefits in proportion to the cost of constructing the project therefore rose dramatically. New reservoirs in the upper regions of the Trinity would combat the lack of year-round water, but whether the amount would be enough was far from certain, especially in view of the demand for water from the growing population and industrialization in the "metroplex."

Believing they saw a new set of conditions, Dallas businessmen decided to renew the push for the canal. John W. Carpenter, president of Texas Power and Light (TP&L), had shown interest in the project in late 1927 when he asked a private engineering firm in Dallas for a summary statement of the feasibility of barge traffic. According to the report, however, the Corps of Engineers stood by its 1921 study and "believed that the project was not an economic possibility and commerce which might develop would not justify such an undertaking. The project," the report continued, "seems to have been entirely abandoned . . . and there seems to be no marked local interest in Dallas or the territory in the further carrying out of the work."[24]

[22] Fort Worth District, Corps of Engineer, *Navigability Study: Trinity River, Tributaries (River Mile 182.7 to 715.0)*, Exhibit 20.

[23] Brown, *Trinity River Canalization*, p. 114.

[24] H. E. McDowell to John W. Carpenter, January 23, 1928, files of the Trinity Improvement Association.

As was the case with other businessmen, Carpenter was convinced, nonetheless, that conditions had changed and went ahead. He was the logical person to initiate the campaign because of his position as head of the largest electric company in central Texas. Rivalry between Fort Worth and Dallas had blossomed into a bitter feud, but cooperation of the two would be essential to win federal approval of the Trinity project. As a utility executive, Carpenter was already acquainted with Tarrant County businessmen, plus those in the other counties along the river. His logical companion in Fort Worth was Amon Carter, publisher of the *Star-Telegram* and well known philanthropist.[25]

After holding several preliminary discussions and recruiting the acknowledged business leaders of the seventeen counties, these two men launched the Trinity River Canal Association (TRCA). Offices were opened in Fort Worth under the management of John M. Fouts who resigned as water commissioner of Dallas to become executive director of the new lobby. To justify its creation, the Association regarded the "old project" as a pork-barrel scheme, but insisted new conditions now warranted the canal: the Denison Act, the growth of north Texas, the expected completion of the Intercoastal Canal and the expected new tonnage that would be shipped on the river as a result of these conditions.[26]

An impressive list of Texas' political leaders were also recruited. Senators Tom Connally and Morris Sheppard endorsed the canal as did Congressmen Fritz Lanham and Hatton Sumners. Members of the Texas legislature from north Texas also stood behind the Association. Indicative of the ambitious drive among the new canal sponsors was the remark by Amon Carter in regard to cooperating with Dallas: "This is the only job that Fort Worth could really join in with Dallas. Don't see how Dallas could gyp us on this thing."[27] But opposition still existed, namely, the railroads which organized several west Texas Chambers of Commerce against the project.[28]

[25] Lowell Duncan, TIA Executive Director, to Clayton Brown, Interview, February 16, 1978.

[26] *East Texas* (October, 1930), 10.

[27] *Minutes*, Trinity River Canal Association, Metropolitan Hotel, Fort Worth, August 28, 1930, files of the TIA.

[28] John Fouts to Amon Carter, July 17, 1931, files of the TIA; "The Trinity Canal," pamphlet, (December, 1932), Mary Couts Burnett Library, Texas Christian University.

To initiate progress the TRCA persuaded the Texas legislature to establish the Trinity River Canal and Conservancy District in May, 1931. Purpose of the District was to erect a legal agency to administer the activities involving the canal. The legislature gave the District the power of eminent domain, the authority to make contracts with the federal government, the authority to conduct surveys, the authority to expend sums of money as necessary to promote the canal, the authority to issue and sell bonds and the authority to levy taxes in the District to retire the bonds. Texas' lawmakers required that the District must have voter approval no later than December 31, 1935. Provision for the latter was made in compliance with the state constitution.[29]

The stage was set for the first of two critical referendums on the proposed canal. Date for the election was August 24, 1935. That summer the TRCA sponsored radio broadcasts on Fort Worth station WBAP and other media advertisements on behalf of the District. Sponsors emphasized the benefits expected to accrue from a canal. At the same time they tried to take advantage of the New Deal liberal call for decentralizing industry. But voters turned down the proposed District, two to one. Some 3,200 of the 23,000 votes were also declared illegal. It was generally acknowledged that voters questioned the wisdom of additional taxes during the depression. And the railroads claimed that a canal on the Trinity was a waste of resources since rail service was available. No environmental issue was raised.[30]

The TRCA was no more successful at the federal level. The Rivers and Harbors Act of 1930 provided for another preliminary survey of the Trinity. On the basis of that study, a broader survey was made. A separate traffic survey completed in 1933 by the Department of Commerce reinforced the TRCA claims that rail rates were disproportionately high. In 1934 the Galveston District filed its report and concluded, however, that the project was not economical.[31]

[29] *Journal of the House of Representatives*, 42d Legislature, Regular Session, (1931), pp. 1962-1964.

[30] Carl J. Baer, Radio Address, Station WBAP, Fort Worth, August 8, 1935, August 16, 1935, files of TIA; Dallas *Morning News*, October 1, 1935.

[31] Department of Commerce, Bureau of Foreign and Domestic Commerce, Inland Waterways Section of Transportation Division, *Economic Survey of the Trinity River in Texas*, Volume I, (September 1, 1933), files of the TIA; Mills, "Navigation of the Trinity River," pp. 36-39.

So far the Corps' studies of the proposal were based solely on navigational use of the stream, and they repeatedly showed no need for a canal. Passage of the 1936 Flood Control Act, however, significantly broadened the criteria used in measuring the benefits of federal water projects. The Act incorporated the principle of multi-purpose planning and the concept of developing whole river basins and not piecemeal development. In other words each water project would be measured in terms of flood control, navigation, water supply, reforestation and recreation. By applying this concept to the Trinity, the results of the Corps studies of the canal would likely be favorable.[32]

Origins of the 1936 Act were rooted in the conservation movement stretching back to the late nineteenth century. Conservationists had long urged comprehensive planning and wise use of water, timber and soil. They favored use of rivers for development, but only through a careful and guarded system protecting the delicate relationship of resources. Steps for replenishing them should also be incorporated into all development plans.

Multi-purpose planning had taken a step forward with the creation of the Tennessee Valley Authority in 1933, and in late 1934 the concept gained further interest when the Mississippi Valley Committee, a special task force of New Deal conservationists headed by Morris L. Cooke to study the Mississippi Valley, filed its report. A well known proponent of multi-purpose planning, Cooke outlined an integrated federal program of public power, flood control, navigation, reforestation, soil conservation and agricultural development for the Mississippi Valley. So impressive was the report that it made front page headlines. The 1936 Flood Control Act also gave the Corps of Engineers the responsibility for river basin development. For the Trinity canal the measure was a milestone because it meant that cost studies of the canal would go beyond navigation. If navigation alone made the canal uneconomical, the flood control features associated with it would make it economical.[33]

For roughly the next ten years a variety of studies were made of

[32] David Temple, "Our Evolving National Water Policy," *American Forests* (September, 1956), 34-41.

[33] Jean Christie, "The Mississippi Valley Committee: Conservation and Planning in the Early New Deal," *The Historian*, XXXII (May, 1970), 449-469.

the Trinity watershed. The United States Department of Agriculture examined soil erosion, while the Galveston District made further studies of the navigation possibilities. The latter recommended in 1939 that a channel be dug from Fort Worth to Galveston Bay, measuring nine feet deep and 150 feet wide. Twenty-six locks and dams would have to be built. Flood control reservoirs on the upper watershed were also recommended. In 1945 Congress authorized those reservoirs: Benbrook, Grapevine, Lewisville and Lavon. The statute also authorized the Fort Worth and Dallas floodways. Each of these features, though justifiable without the canal, were nonetheless related to the eventual development of a navigable Trinity. Still, Congress had not authorized the canal.[34]

Congressional authorization of the reservoirs on the upper Trinity was a tribute to the organizing and lobbying power of the canal's promoters. In 1938 the TRCA had merged with the Trinity Watershed Soil Conservation and Flood Control Association to form the Trinity Improvement Association (TIA). Identification with soil conservation was necessary for the promoters because the Roosevelt Administration had emphasized the need to protect America's soil from abuse. When Congress passed the Conservation Act of 1935 it authorized a complete study of soil in the Trinity watershed. It was obvious that any effort to promote a canal would have to include provisions for soil conservation. Accordingly the TRCA joined forces with the other Association in order to pay recognition to soil conservation. A new board of directors and officers were elected, but the goal of the new TIA remained the same—federal construction of a canal from Fort Worth to Galveston Bay.[35]

The first real work toward the canal came in 1945 when Congress appropriated funds for the construction of reservoirs on the upper Trinity and approved a plan for a nine foot navigable waterway from Fort Worth to Galveston Bay. But Congress only authorized construction of a channel up to Liberty. When work started on these particular reservoirs—Benbrook, Grapevine, Lewisville and Lavon—the Galveston District opened an area office in Fort Worth which, of course, became the FWD in 1950.

[34] Barbee, "Review of Historical Documentation Related to Early Commerce on the Trinity River," pp. 4-5; Mills, "Navigation of the Trinity River," pp.43-45.

[35] Ibid., p. 39.

Thus, the origins of the FWD were directly related to the general effort for the Trinity canal.[36]

The project had a long history before the FWD existed. Since 1880 the Galveston District was responsible for the surveys and studies. Construction of the reservoirs on the upper Trinity was initiated by the Galveston District and taken over by the FWD when it went into operation in 1950. The latter completed Benbrook and Grapevine in 1952. Lavon was finished in 1953 and Lewisville in 1954. Construction of the Fort Worth floodway also occurred at that time. But federal interest in the canal and its associated projects languished owing to the preoccupation with the Korean conflict. President Dwight D. Eisenhower also ordered a reduction in federal spending which set back the canal, and the Dallas floodway was delayed for several years until funds were approved. Though necessary to protect Dallas from the rampaging Trinity, the floodway was a vital part of the plan for the canal. The severe Texas drought of the 1950's followed by the 1957 floods, however, dramatically renewed interest in the canal because its proponents pointed to the benefits of water supply and flood control that were part of the comprehensive plan for the Trinity. And the TIA obtained a strong endorsement from the state legislature when it created the Trinity River Authority (TRA) in 1955.[37]

In order to coordinate the activities of the Texas state government with the federal, the TIA lobbied in Austin for the creation of a special agency to oversee the development of the Trinity. The idea behind such an agency resembled that associated with the old Trinity River Canal and Conservancy District—to make full use of the state government in getting a canal on the Trinity. It was also necessary to establish a state agency in order to meet the obligations of local interests in congressionally authorized water projects. For these reasons TIA president John Carpenter wrote: "We are engaged in setting up the Trinity River Authority, an agency of the State of Texas,

[36] Robert Craft, "History of the Fort Worth District, U. S. Army Corps of Engineers," typescript, (March 4, 1975), 101-102.

[37] Lynn M. Alperin, *Custodians of the Coast: History of the United States Army Engineers at Galveston* (Galveston, 1977), 5; "Importance of Continuance of Construction on the Flood Control and Water Conservation Projects of the Upper Trinity Basin," typescript (July 11, 1950), SWD files; "Remarks of Major General S. D. Sturgiss, Jr. before TIA," Dallas, Texas, April 15, 1950, SWD files.

which is to be charged not only with the power but also the duty of carrying out our Master Plan."[38]

Creation of the TRA came in 1955. It was established as a political subdivision of the state, comprising all the territory contained in Tarrant, Dallas, Ellis, Navarro and Chambers counties, plus that portion of the counties lying within the Trinity watershed. Governed by a board of twenty-four directors appointed by the governor, the TRA had responsibility for flood control, soil and water conservation, and water storage for agricultural and municipal use. To accomplish this objective, the TRA was required to develop a master plan for the Trinity River basin—the plan included navigation. The legislature empowered the agency to levy a property tax of two cents per one hundred dollars of county valuation.[39]

The new agency conducted public hearings in fifteen of the seventeen counties in the Trinity watershed so as to discuss and weigh all alternatives and proposals in its master plan. As described by one economist, the plan adopted by TRA in 1958 was grandiose. It called for 1200 small rural dams, 49 major reservoirs, a regional sewage disposal system, recreational facilities and "the construction of those facilities necessary to reestablish waterway transportation on the Trinity to Fort Worth and Dallas."[40] Remembering the outcome of the old Conservancy District in 1934, the TRA directors waived their right to collect fees and expenses and did not submit a tax proposal.

Encouraged by its success with the state legislature, the TIA conducted its own economic survey of the Trinity in 1957 to show the amount of barge traffic that would likely occur if the canal were built. Purpose for the study however, was to refute the Corps' 1921 study showing too little anticipated traffic to warrant a canal. According to a new study made by two firms, Freese and Nichols, and Forrest and Cotton, the Fort Worth-Dallas area had grown industrially more than enough to justify the canal. They also reported that enough water was available for a canal. Simultaneously a specially organized study of water in Texas was being conducted by the Texas Board of Water Engineers, the

[38] John W. Carpenter to the President, March 10, 1954, SWD files.

[39] *Progress Report, Trinity River Authority of Texas*, June 1, 1962 thru December 31, 1963, pamphlet, SWD files.

[40] Ibid., p. 7; Durham, *Trinity River Paradox*, p. 105.

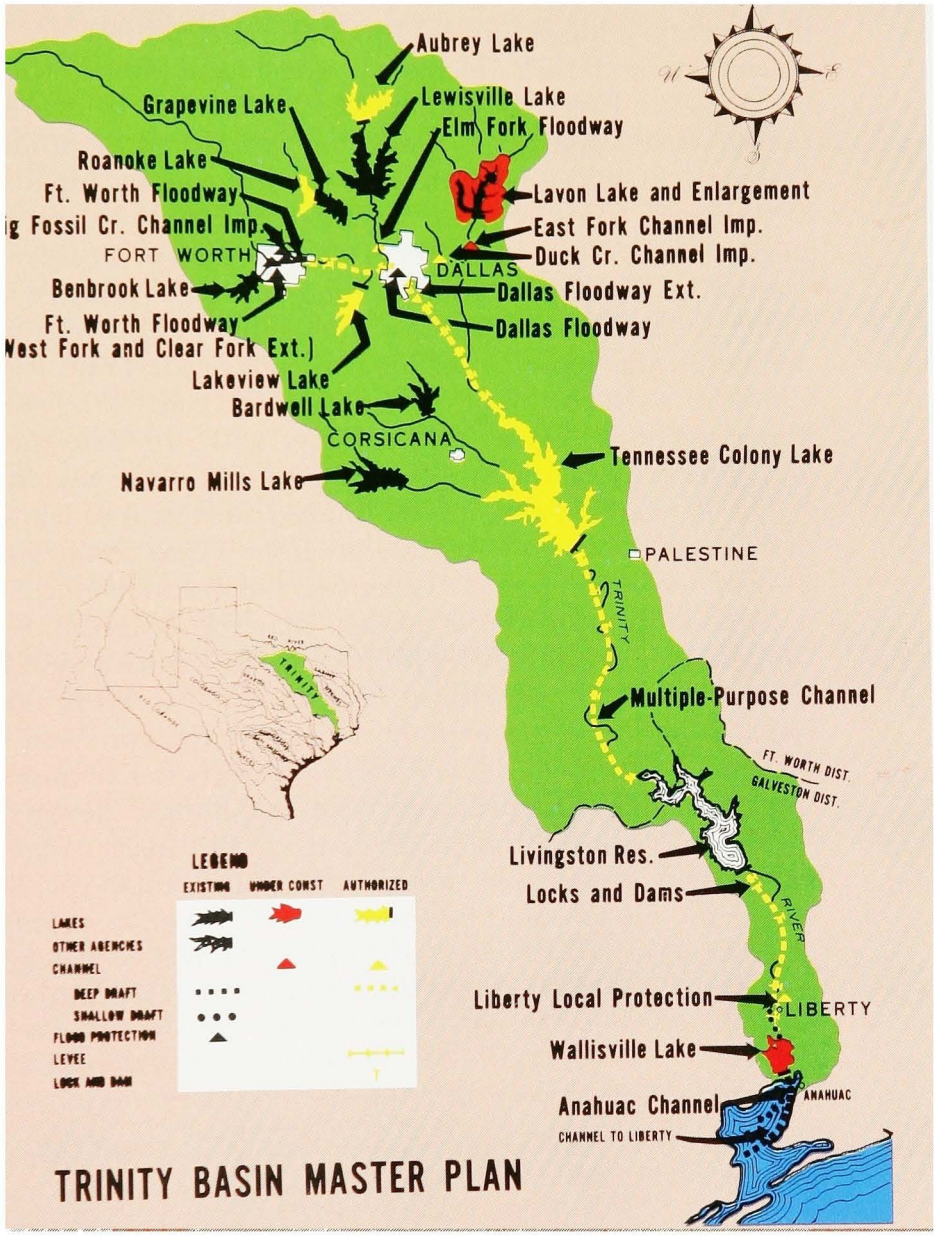
Southwestern Division Corps of Engineers, the Bureau of Reclamation and the Soil Conservation Service. Initiated by Senate Majority Leader Lyndon B. Johnson and regarded as one of the most comprehensive examinations of water in Texas, this joint report, published in 1958, made reference to the TIA study and accepted its conclusion that the benefit-cost ratio of the canal was 2.09 to 1. The joint report also endorsed the TRA's recommendation for new reservoirs for water supplies and navigation.[41]

Faced with an upsurge of local interest and new evidence pointing to the economic feasibility of the proposed canal, Congress in 1958 authorized the FWD and Galveston District to conduct jointly a full scale study of the project. It was this study along with a followup review in 1965 that led to the emotional campaign against the canal in 1973. Completed June 30, 1962, the survey recommended the construction of (1) a multi-purpose channel for flood control, water transportation and recreation, (2) four multi-purpose reservoirs: Tennessee Colony, Aubrey, Lakeview and Roanoke, (3) five floodway control systems: West Fork Floodway, Elm Fork Floodway, Dallas Floodway Extension, Duck Creek Channel Improvement and Liberty Local Protection. Total construction cost was put at $900,747,000 with an annual operation, maintenance and replacement cost of $8,447,000. Total annual charges were set at $38,910,000 with annual benefits estimated at $62,420,000. The ratio of benefits to costs was 1.6-1.0.[42]

Navigation features of the plan included a channel 12 feet deep by 150 feet wide and 362.8 miles long. Spur channels and turning basins at Fort Worth and Dallas were also included. The project would need 23 navigation locks and 19 dams, including the Wallisville Lock. Nineteen of the locks below Dallas would be 84 feet wide by 600 feet long, and the remaining four would be 54 by 400. Alterations to bridges and utilities would also be required. The report was reviewed by the Southwestern Division in Dallas, the Office of the Chief of Engineers, the Board of Engineers for Rivers and Harbors and the Public Works Committee of the

[41] Ibid., pp. 105-106; U. S. Senate, 85th Congress, 2d Session, Document #111, *Water Development and Potentialities of the State of Texas* (June, 1958), pp. 106-121.

[42] U. S. Army Engineering Districts, Fort Worth and Galveston, *Comprehensive Report on Trinity River and Tributaries, Texas* (June, 1962); Trinity Improvement Association, "The Trinity River: A Historical Perspective," typescript, pp. 15-16, TIA files.


Aubrey Lake
Grapevine Lake
Lewisville Lake
Elm Fork Floodway
Roanoke Lake
Ft. Worth Floodway
Lavon Lake and Enlargement
East Fork Channel Imp.
Duck Cr. Channel Imp.
FORT WORTH
DALLAS
Benbrook Lake
Dallas Floodway Ext.
Dallas Floodway
Lakeview Lake
Bardwell Lake
CORSICANA
Tennessee Colony Lake
Navarro Mills Lake
PALESTINE
TRINITY
Multiple-Purpose Channel
FT. WORTH DIST.
GALVESTON DIST.
Livingston Res.
Locks and Dams
RIVER
Liberty Local Protection
LIBERTY
Wallisville Lake
Anahuac Channel
ANAHUAC
CHANNEL TO LIBERTY
LEGEND
EXISTING
UNDER CONST
AUTHORIZED
LAKES
OTHER AGENCIES
CHANNEL
DEEP DRAFT
SHALLOW DRAFT
FLOOD PROTECTION
LEVEE
LOCK AND DAM
TRINITY BASIN MASTER PLAN

House of Representatives. Quick approval was expected, especially in view of the fact that long-time canal backer Lyndon Johnson was President. Much to everyone's surprise, the Bureau of the Budget did not recommend the project in the 1965 budget.[43]

Alarmed by this move, proponents of the canal organized one of the largest displays of support for the project. In February seven hundred businessmen, civic leaders and public officials held the Trinity River Development Conference at Austin. They unanimously approved a resolution introduced by former Texas Governor Price Daniel asking for prompt congressional approval of the canal. "Trinity River development is one of the really great projects this state has undertaken," stated Governor John Connally, "and one in which we must succeed. We need action in Congress this year." Almost the entire Texas congressional delegation was represented, plus officials of the Texas legislature. Lyndon Johnson had earlier stated that "the proposed development of Texas' Trinity River will stimulate the growth and prosperity of the area to a degree that defies description."[44]

The display did not stir the Budget Bureau into action. After more delay, which invoked threats from Texas congressmen, the Bureau sent its report to Congress, but recommended that the navigation feature of the master plan be dropped! Some 280 supporters, a weighty delegation of Texas' political and business leaders, attended the House hearing on the canal, hoping to impress the committee with the support in the Lone Star State for the canal. Still, the House Rivers and Harbors Committee in its final recommendation agreed with the Budget Bureau.[45]

Congress, nonetheless, authorized the full master plan, but in recognition of the reservations about the canal, specified that before any funds would be appropriated for construction of those features relating to navigation, the Corps had to submit a new review of the navigation cost. When the reevaluation was

[43] Ibid.; Barber, "Review of the Historical Documentation Related to Early Commerce on the Trinity River," pp. 6-7; Arthur W. Wenske, "A Study of the Circumstances Surrounding Final United States Government Approval for Navigation on the Trinity River," typescript (May, 1969), p. 7, SWD files.

[44] Both quoted in *Southwestern Water Resources Report*, special newspaper edition, February, 1965, Mary Couts Burnett Library, Texas Christian University.

[45] U. S. House, Subcommittee on Flood Control of the Committee on Public Works, *Hearings, Omnibus Rivers and Harbors and Flood Control Bill 1965*, 89th Congress, 1st Session, pt. 2, pp. 707-730.

complete in 1968, it showed a benefit-cost ratio of 1.5-1.0 based on 1967 price levels. The FWD had also modified the channel by widening it to 250 feet and adding more locks. To promote water purity in the river, an eighty-four inch pipeline from the proposed Tennessee Colony Lake to Benbrook Lake was included in the 1968 modifications. With the strong political support of the canal and the completion of the FWD study showing the navigation benefits at 1.5, the project seemed destined to become a reality. New questions arose, however, which put the project in jeopardy.[46]

Beginning in the early 1960's public concern arose over the effect of technology on the environment. As urbanization spread it became obvious that pollutants had already wrought irrevocable damage to the earth and atmosphere and unless preventive measures were taken further damage would occur. Irreplaceable loss of natural beauty and resources were recognized as the consequences of careless development. Rachel Carson expressed this growing uneasiness in her book, *Silent Spring*. "Man acquired significant power to alter the nature of his world. During the past quarter century the power has not only increased to one of disturbing magnitude but it has changed in character. The most alarming of all men's assaults upon his environment is the contamination of air, earth, rivers and sea . . . ."[47] In response to the mounting concern over the environment, Congress passed the National Environmental Policy Act in 1969, which required all public bodies to conduct studies of the impact of all projects on the environment. Environmental statements had to be made and public hearings held. For the FWD this meant an examination of the full effect the canal would have on the flora and fauna of the Trinity watershed.

Pursuant to the directive of the 1969 Act, the FWD arranged for Stephen F. Austin State University at Nacogdoches, Texas, to conduct a study of the environmental and cultural impact of the proposed channelization of the Trinity. Completed in September, 1972, the report dealt with history, geology, biology, soil and forestry, fowls and mammals, fish and pesticide use. In each case

[46] *A Report of the Chief of Engineers, Department of the Army, together with the Report of the District and Division Engineer on Reevaluation of the Navigation Features of the Project for the Trinity River, Texas, Pursuant to the Provisions of the Rivers and Harbor Act of 1965*, 90th Congress, 2d Session (July 18, 1968), pp. 2-3.

[47] Rachel Carson, *Silent Spring*, (Barton, 1962), 5-6.

the researchers discoverd that damage would occur unless precautions were taken. Soil moisture was expected to decrease in the upper watershed and thereby retard plant growth and agricultural production. Soil erosion was expected in specific areas. To protect fish the professors recommended construction of fish sanctuaries and blocking oxbow lakes to provide a permanent habitat for fish. Similar recommendations were made for each category of the study. The tenor of the University's report was contained in the following passage: "the overall beneficial effects will at least balance or perhaps exceed the detrimental effect if sound management techniques and proper canal construction techniques are utilized."[48]

Specific opposition to the canal on environmental grounds did not begin until the 1960's. Opponents had always based their arguments on economics; mainly it was a matter of rail versus water transportation. Some west Texas cities had wanted the money spent on water development in their area. Environmentalists and naturalists in Dallas testified against the project in the mid 1960's. Edward Fritz fought the channelization of Brachman Creek by the city of Dallas, and he went to court with the city about his yard. He preferred not to plant grass, but let weeds take over. Neighbors complained, but Fritz replied that weeds were the natural plants of his yard. He won the case.[49]

By 1972 environmental opposition to the canal had grown. James Bush of Kerens, Texas, had organized a group of students at Navarro Junior College against it. James F. White, professor of theology at Southern Methodist University (SMU) Perkins School of Theology, linked up with other opponents and raised funds to fight the project.

Donald Smith, professor of economics at SMU, joined the growing band. Smith based his opposition on the calculations made by the FWD in measuring the benefit-cost ratio. Had the FWD used the "going rate" of interest, which was considerably higher than the 3.25 percent dictated for use in the study by law, the benefit-cost ratio was .60-1.00, or only sixty cents return on each dollar invested. In April, 1972, these environmentalists

[48] Jack E. Coster, editor, *A Survey of the Environmental and Cultural Resources of the Trinity River*, Stephen F. Austin State University (September 1, 1972), p. 302.

[49] Dave McNeely and Lyke Thompson, "The Unholy Trinity Incident," *Texas Monthly*, I (June, 1973), 44.

founded COST—the Citizens Organization for a Sound Trinity. Opponents tested their muscles when they filed an injunction in a Houston federal court against the continued construction of the Wallisville Reservoir. Approved in 1968, work on the project, which was part of the TRA master plan and a vital link in the canal design, had commenced in 1971.[50]

The anti-canal contingent gained a particularly strong ally when congressional candidate Alan Steelman joined them. Steelman was a valuable ally because he was a conservative Republican running for the fifth district located in the heart of the traditionally pro-canal area of Dallas. He referred to the project as the "billion dollar ditch." Surprisingly Steelman won the race. But the environmentalists were still in the minority, and the proponents remained confident. The latter included not only a large portion of Texas' high ranking political figures but also small town mayors and business interests.[51]

Only sponsors of the canal and environmentalists were thus far involved in the fight. The FWD was caught in the middle. The battle escalated when TRA General Manager David Brune announced in February, 1973, that a special bond election in the seventeen watershed counties would be necessary in order to raise $150,000,000 as the local contribution to the project. The TRA wanted authority to place a property tax of 15¢ on each $100 evaluation. Date for the election was March, 1973. The "Battle of the Trinity" started.[52]

Proponents chose Dallas attorney Thomas C. Unis, former city council member, to head their campaign. Unis proceeded to organize the Trinity Opportunity Development Committee and recruit as many supporters as possible, preferably well known political and business leaders. An example of his recruiting was the role taken by Tarrant County congressman James Wright. Normally congressmen avoid local contests, but Wright fought hard on behalf of the project. But he had supported the canal since he first went to Congress in 1955 and his participation was expected.[53]

Unis' strategy was described as a "high priced professional

[50] Ibid.; Houston *Chronicle*, April 29, 1972.
[51] McNeely and Thompson, "The Unholy Trinity Incident," p. 44.
[52] Dallas *Times Herald*, February 3, 1973.
[53] Dallas *Morning News*, March 15, 1973.

advertising campaign." He focused on formal groups such as Rotary Clubs, and for campaign volunteers to make telephone calls he relied on young businessmen recruited from downtown Dallas. The message of the sponsors remained the same: a Trinity canal would greatly enhance the economic development of the Fort Worth-Dallas area; construction of the project would provide numerous jobs; and the public would have recreational benefits and a clean river.[54]

Opponents used a different strategy. With a smaller amount of funds they concentrated on rank and file voters. Single page leaflets were circulated en masse, and campaign volunteers were expected to show up for the sake of ecology. Instead of seeking endorsements from well known figures, they fed the public with detailed information about benefit-cost ratios, claims about barge traffic and the like. They also concentrated on taxpayers' fear of cost and the fear that new reservoirs, ports and supporting apparatus would be added to the original project. When the TRA agreed to consider extending a linking canal to Garland and Mesquite, which was not in the Corps' design, these fears seemed well grounded to many voters. The new sources of water associated with the canal, the environmentalists continued, could be furnished without constructing a canal. Straightening the 550 mile river into a 360 mile concrete canal would forever ruin much natural beauty and destroy wildlife and fish habitats.[55]

Opponents expressed their concern over the effect of the canal on wildlife in the lower Trinity basin because it teemed with a variety of mammals, reptiles and birds. Some were on the list of endangered species. Any project that would endanger or possibly bring to extinction exotic creatures such as the Red-Bellied Woodpecker struck many environmentalists as wasteful and morally wrong.

Throughout the campaign foes of the canal accused the TRA of deliberately setting the date of the election too early for the returns of two studies being conducted by the FWD—a revaluation of the project's cost and an environmental statement. The implication was clear: that the proponents were afraid the studies would be unfavorable and wanted the election held before

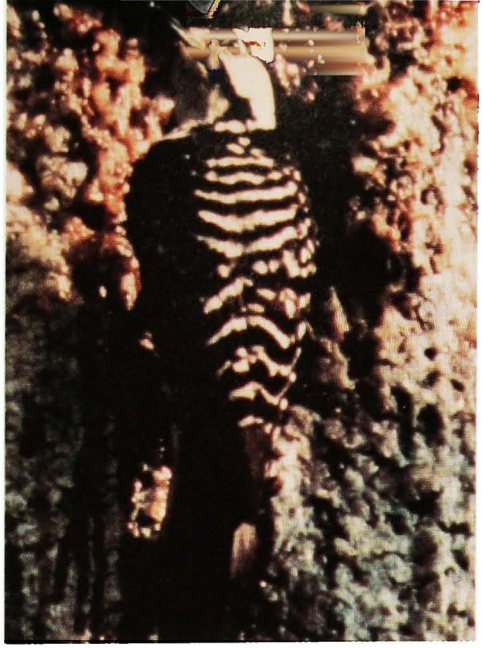
[54] Ibid.

[55] James M. Miller, Corps of Engineers, to Senator Lloyd Bentsen, January 29, 1973, SWD files; Henry C. Fulcher, Jr., editorial comment, Dallas *Morning News*, July 3, 1972.

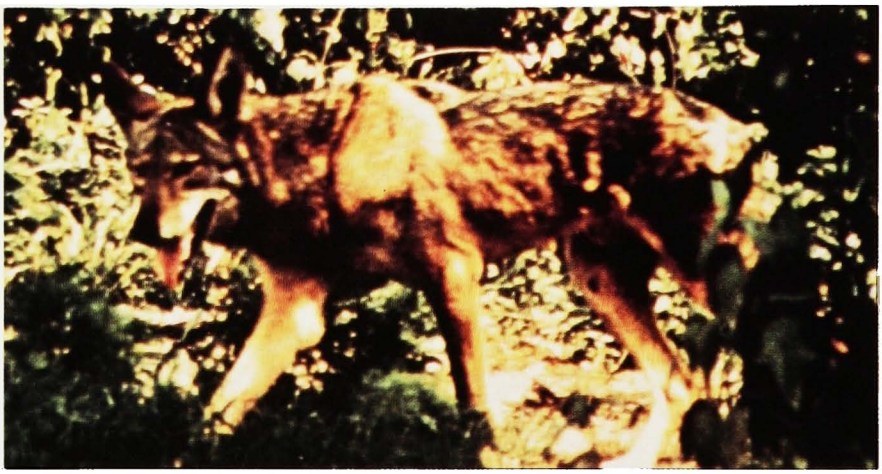
A Reddish Egret, designated an endangered species. (Texas Parks and Wildlife Commission)

The American Alligator, inhabitant of the lower Trinity River. (Texas Parks and Wildlife Commission)

The Redbellied Woodpecker, inhabitant of the Trinity River woodlands.



The Red-Cockaded Woodpecker, a threatened species. (Texas Parks and Wildlife Commission)



The Red Wolf stalks his prey in the Trinity River bottomlands. (Texas Parks and Wildlife Commission)

The Golden-Cheeked Warbler. (Texas Parks and Wildlife Commission)

they were finished. But the FWD cost analysis had been filed in 1968, and the District saw no reason for another. Environmentalists were referring instead to their charge that the 3.25 percent interest rate used by the FWD was unrealistic and another analysis based on the 1973 market price of money should be made. No new study was underway. The FWD felt it was not necessary; indeed the District had no authority for one.[56]

The second charge was more accurate. In order to comply with the National Environmental Policy Act of 1969, the FWD was engaged in a comprehensive study of the environmental impact of the canal on the Trinity River basin. The study conducted by Stephen F. Austin University was part of the District's larger examination. It was true that the Environmental Impact Statement (EIS) would not be finished by the date set for the election. It was impossible for the FWD to complete the study by that time, and the District was also not accountable for the election date. Responsibility for the latter rested with the TRA.

Probably the most dramatic event in the struggle was the decision on an injunction filed the previous year to stop progress of Wallisville Reservoir under construction by the Galveston District. Environmentalists charged that Wallisville, though authorized as a separate project by Congress, was an integral part of the canal. Six parties—the Sierra Club, the Houston Sportsmen's Club, the Audubon Society, the Texas Shrimp Association and two fishermen—had insisted that completion of the reservoir, located near the mouth of the Trinity, would destroy the breeding and nursery grounds for shrimp, crabs and menhaden. Fish losses were estimated at 7,000,000 pounds per year. Though funded separately from the canal project, Wallisville was a vital link in the master plan. According to the plaintiffs, the Galveston District had violated the National Environmental Policy Act by starting construction before the results of the Corps' environmental study of the reservoir were known. Hence, work should stop, according to the petitioners, either temporarily or indefinitely, depending on the results of such a study. As contained in the design of the canal, Wallisville would operate in conjunction with Lake Livingston, a reservoir upstream already in use by the city of Houston, to supply the

[56] Ibid.; Arlington *Daily News*, February 27, 1973; Dallas *Times Herald*, February 3, 1973.

channel with enough water to sustain barges. Wallisville Lake was also to act as a barrier and protect rice growers from salt water intrusion, an old problem expected to worsen when the Trinity was dredged for a canal. In February, 1973, Judge Carl Bue halted construction of Wallisville.[57]

The Corps, consisting of the Fort Worth and Galveston Districts since both were involved in the litigation which included the Trinity project (FWD) and the Wallisville project (Galveston District), filed an appeal in the Fifth Circuit Court which reversed and remanded Judge Bue. The reversal, which found no nexus between the reservoir and the navigable waterway, a point reinforcing the FWD's navigation study, did not come until August 26, 1974. In the meantime Bue's decision provided adverse publicity for the FWD and the canal's sponsors.[58]

Judge Bue's decision coincided with a staged display on February 17 by Fritz and congressman Steelman to canoe down the Trinity near the Wallisville site. Purpose for the excursion was to dramatize the effect the canal would have on the area. Newspaper reporters were prepared to record their departure downstream when news came that Judge Bue had ruled against the Corps and stopped work on the reservoir.[59]

Proponents of the canal never fully addressed themselves to other issues; one was the expense of building port facilities at Fort Worth and Dallas, estimated at $125,000,000. The bond proposal did not include provisions for that cost. By law the Corps of Engineers was not responsible for port facilities, and the FWD had not included them in its study. In this respect taxpayers had a legitimate complaint since they received no explanation for funding the ports. An even broader question, however, dealt with the definition of the quality of life. Organizations such as TIA and TRA had predicted that a canal would promote economic development, that when cheaper water transportation became available industrial firms would move to the area and growth would mushroom. It was good economics to build the canal. Opponents disagreed.

[57] Trinity River Authority, "Trinity River Basin Master Plan," pamphlet, February 22, 1977, p. H1; Houston *Chronicle*, April 29, 1972.

[58] Bud Rolfe, FWD, to Clayton Brown, Interview, March 16, 1978.

[59] McNeely and Thompson, "The Unholy Trinity Incident," *Texas Monthly*, p. 47.

They questioned such growth, saying that more factories and people would spoil the quality of life. Factories would pollute the air, more effluents would have to be discharged, and the anticipated surge of population would cause overcrowding and burden public schools and other municipal services. "Dallas is now one of the cleaner cities," wrote one citizen, "and I hope we can keep it that way with only moderate growth."[60] By revaluating growth, which had also occurred in other states and countries, opponents introducted a new concept in evaluating water projects. Environmentalists offered no reply to the claim that the canal would cleanse the Trinity, long used for municipal refuse.

In the midst of the campaign another event reinforced the environmentalists. The National Water Commission, a federal advisory group, completed an impressive study of water in the United States. In a hardhitting document, it concluded that channelization projects paid scant attention to environmental questions, particularly the loss of esthetic value, loss of vegetation, soil erosion and the lowering of the water table. Local beneficiaries of such projects should also have to pay a larger share of the cost. The Commission did not specifically refer to the Trinity, and it agreed that projects such as the one proposed in Texas were more hydraulically efficient and had economic benefits. But the report was interpreted as a setback for the project.[61]

By election day, March 13, the proposed canal had become an emotional issue. Voters in Dallas turned out in high numbers, nearly five times more than in the junior college bond election. The same was true in Fort Worth. For the proposal to carry it needed a majority in the total number of votes, and it had to carry in nine of the seventeen counties. It lost heavily in both counts. Seven of the downstream counties approved the project, but they were overwhelmed by the large turnout in the metropolitan areas. The final tally showed 54 percent of the ballots against, but in some Dallas and Fort Worth precincts voters rejected the proposal over six to one.[62]

[60] Dallas *Morning News*, March 5, 1973.

[61] U. S. National Water Commission, *Water Policies for the Future: Final Report to the President and to the Congress by the National Water Commission* (Port Washington, New York, 1973), pp. 32-37.

[62] Dallas *Morning News*, March 14, 1973.

Newspaper coverage of the dispute had been thorough, and even the national press picked it up. Out of state reporters and editors wrote that it had been a David and Goliath battle. Sponsors of the canal had spent $400,000 compared with the $15,000 of the environmentalists. The outcome, the *Christian Science Monitor* reported, was a great surprise and "swamped all projections for reviving the idea in the future."[63] Two factors apparently killed the proposal: (1) the environmental question, and (2) the cost. By the latest estimate, the canal would require 1.6 billion dollars, not including several reservoirs such as Wallisville and Livingston that were part of the concept for the canal. Henry Fulcher, leader of COST, was a Dallas businessman, a large lumber importer named the "Importer of the Year" in 1972 by the Dallas Market Center. For him the availability of a navigable waterway would make no difference.

Defeat at the polls left the proposed canal in a state of limbo. The Galveston District had not resumed construction of the Wallisville Reservoir by July, 1978, because certain aspects of Judge Bue's decision in regard to the environment had not been resolved. When his decision came in 1973 the reservoir was approximately 75 percent complete. Lake Livingston, which had been built in conjunction with the city of Houston for water supply, went into operation in 1969. The other projects in the master plan were left in a questionable state. By December, 1977, Congress had provided funding for the Tennessee Colony Reservoir, Aubrey and Roanoke Lakes, the Duck Creek and Dallas Extension Floodways and the protective levees for the city of Liberty. Congress had funded Lakeview Reservoir and land acquisition was in progress after clarification of Judge Bue's decision. The FWD's environmental study was still underway, delayed by new criteria for making an EIS and by lack of congressional funding.[64]

For all practical purposes the proposed canal was dead. The FWD would likely make improvements on the river on a piecemeal basis, but any project associated with the canal would also likely be challenged. In reference to the other projects, Charles Crabtree, chairman of the Tarrant County Chapter of

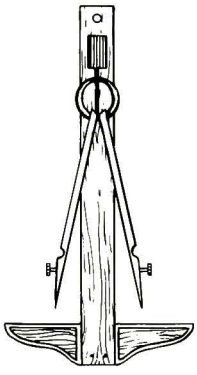
[63] Quote in *Christian Science Monitor*, March 28, 1973; ibid., July 25, 1973.

[64] Robert Craft, FWD Public Affairs Officer, to Clayton Brown, Interview, March 17, 1978; Bud Rolfe to Clayton Brown, March 16, 1978.

COST, said: "COST is not opposed to the Trinity River Project in its entirety. We are against the canal."[65] A spirit of compromise was therefore apparent because one TRA officer replied: "If we have to disassociate the canal from other water resources, we will work with the opposition to salvage the generally accepted benefits."[66]

Through the experience with the bond election, it was clear that the canal project could no longer expect to receive unrestricted support from the people of Texas. The ideology of development so extant a generation earlier was on the wane. Environmentalists would probably not oppose new reservoirs built solely for water supply, but they could be expected to fight vigorously another push for the canal. In the future the District would probably encounter stiff public resistance to any massive alteration of the environment.

[65] Fort Worth *Star-Telegram*, March 4, 1973.
[66] *Christian Science Monitor*, July 25, 1973.



CHAPTER VI

The Corps and Its Critics

Resistance to the proposed Trinity canal coincided with the general opposition to water and navigation projects of the Corps of Engineers throughout the United States. Several of the principal charges brought against the canal were identical to charges against not only Corps projects in other states but also growth and development under any aegis. The Trinity project provided, therefore, an opportunity to examine the environmental question in the country and also interpret the record of the FWD in view of the charges against the Corps.

To begin with, critics accused the Corps of acting irresponsibly, of needlessly destroying natural beauty and the environment. Allegedly, the Corps continues to build dams and other projects when they are not warranted. And all of this destruction, so the argument continues, is accomplished at excessive cost to the taxpayer. Vice-President Walter Mondale expressed this view when he compared the Corps with a beaver "whose instinct tells him to build a dam wherever he finds a trickle of water. Like the Corps, this little animal frequently builds dams he doesn't need, but at least he doesn't ask the taxpayers to foot the bill."[1]

Critics have made a careful distinction, however, in their assessment of the agency. They pointed out that the Corps has no

[1] Elizabeth B. Drew, "Dam Outrage: The Story of the Army Engineers." *The Atlantic*, CCXXV (April, 1970), 51.

reputation for scandal and corruption, that according to even the most ferocious critic, "it is honest . . . and efficient."[2] The Corps has "been a very important force in American life with few questions asked," wrote another critic.[3] Nearly all dissenters recognized the historic role of the Engineers in developing water resources whether for flood control, hydropower or other uses. Attacks against the agency, though involving specific projects, were an expression of the current reassessment of the importance of economic development compared with protection of the environment.

Prior to the current criticism of the Corps, attacks dealt with the methods employed by the agency in preventing floods. Dissenters seldom questioned the worth of flood control. Exemplifying this attitude was Elmer Peterson, author of several books, including *Big Dam Foolishness* published in 1954. Floods should be prevented, he agreed, but with small structures on the upper watersheds of river basins. Careful management of vegetation and forests, terracing and construction of small private lakes and ponds would prevent massive floods and remove the need for huge dams. In other words, early day critics took the view of the Soil Conservation Service—that floodwaters should be stopped in the fields and meadows and not allowed to flow unchecked until they turned into rampaging rivers.[4]

Peterson's approach to flood control was known as the "upstream phase." The "downstream phase" involved reservoirs, and as stated by one authority, "controversy had developed concerning the relative efficacy of and need for various parts of the two programs."[5] Dissatisfaction with the Corps came from the proponents of upstream conservation. No questions were raised about the need for flood control, about the mentality of Army engineers, about the alleged political maneuvering by the agency, and no one said the Corps "commits rape with bulldozers."[6]

If hardly a generation ago the Corps was, therefore, relatively free of criticism, how did a portion of the public come to regard it

[2] William O. Douglas, "The Public Be Damned," *Playboy* (July, 1969), p. 182.

[3] Drew, "Dam Outrage," *Atlantic*, p. 52.

[4] Elmer Peterson, *Big Dam Foolishness: The Problem of Modern Flood Control and Water Storage* (New York, 1954).

[5] Luna B. Leopold and Thomas Madlock, Jr., *The Flood Control Controversy: Big Dams, Little Dams and Land Management* (New York, 1954), p. ix.

[6] Gene Marine, *America the Raped: The Engineering Mentality and the Devastation of a Continent*, (New York, 1969), 16.

with such animosity. A variety of factors were responsible, including cost and the concept of "zero growth," two important issues in the debate over the Trinity canal. The expense of building projects and the opposition to them rose swiftly and simultaneously. Their parallel rise was not wholly coincidental.

Central to the cost analysis of water projects is the rate of interest which each District uses to compute an imaginary amortization schedule. Federal law requires this step because each project must justify its cost over a fifty year period. Each District must take into consideration that the money used in a project could be appropriated for another public use. During the 1950's when water development was more popular, the Districts calculated cost on their respective projects with an interest rate varying from 2 to 3 percent. Long term rates in the open market for the same decade, based on composite averages, was 2.31 percent. Expenditures on projects were, therefore, not out of line with comparable capital investments by private enterprise.[7]

Beginning in the 1960's, however, long term interest rates climbed owing to economic and population growth and the Viet Nam conflict. By 1970 the composite average had risen to 4.51 percent and by 1975 the figure was 6.37 percent.[8] But Congress froze the rate of interest on all Corps projects approved by 1969 at 3.25 percent. Whenever the benefit-cost analysis of a particular project was conducted after the hike in rates and showed a favorable ratio, critics said the ratio would be unfavorable if the Corps used an interest rate more in line with the real cost of money. Such was the case with the Trinity project. Dr. James F. White, Chairman of the Executive Committee of COST, stated: "We feel that if the right interest figure were used, the thing would definitely be economically not feasible."[9] The rate of interest was, of course, set at 3.25 percent by Congress.

Defenders of the 3.25 percent currently reply that such expenditures are warranted because of anticipated economic development. They correctly point out that among all federal civil projects, only water projects must be economically justified. Construction of highways, post offices and bridges, medical and space research, soil and forestry conservation and still other

[7] Sidney Homer, *A History of Interest Rates* (New Brunswick, 1977), 500-501.
[8] Ibid., p. 501.
[9] Fort Worth *Star-Telegram*, April 19, 1972.

projects of inestimable public benefit are not required to meet cost requirements. Defenders frequently ask: What would have happened if the government had not committed funds in those areas? As stated by one economist, expenditures on Corps projects may "yield a stream of external economies which, while not appearing as primary project outputs, nevertheless accrue as economic benefit to the community at large."[10] That unforeseen benefits may come from expenditures is a legitimate point, but as long as federal law requires water projects to prove their merit through a vigorous cost analysis, taxpayers also have a legitimate complaint. The National Water Commission recommended that the Corps use a rate of interest based on the yield rate on United States Treasury bonds, which in 1973 at the time of the Trinity bond election was 5.50 percent. Resolution of this disagreement lies in the political arena, an arena forbidden, however, to the Corps.[11]

Interest rates used in computing project costs are only part of the larger and highly complex debate over the Corps' methodology in measuring costs and benefits. To ascertain the cost of a project, each District examines not only the initial construction expense but also operation and maintenance cost over a long period (50 years for canals and 100 years for reservoirs).[12] All known tangible costs lying within the prerogative of the government must be included, even intangible factors such as the loss of revenue from sports fishing if a popular fish habitat is destroyed. Benefits include expected savings such as lower freight rates, a much discussed point in the case with the Trinity canal. Benefits must exceed cost by a ratio of one to be approved, though in rare cases Congress has funded projects with lower ratios. Probably no aspect involved in approving federal expenditures has drawn more criticism than the Corps' benefit-cost analysis. While some economists, engineers, ecologists and congressmen endorse the ratio equation used in the analysis,

[10] Robert H. Haveman, *Water Resource Investment and the Public Interest: An Analysis of Federal Expenditures in Ten Southern States* (Nashville, 1965), 26.

[11] Dallas *Morning News*, December 1, 1972. For discussion of unforeseen benefits, see Durham, *Trinity River Paradox*, pp. 218-244; Karl Mundt, "MVA Report: Revision in Calculating Cost-Benefits Ratio," *River Pilot* (May, 1969), 18-22.

[12] Ibid., p. 18.

others regard it as ambiguous, contradictory and incomplete.[13]

The casual observer quickly loses himself, and understandably so, when he sees the equation. It is

$$Z = \frac{\Sigma \frac{B}{(1+i)^t}}{K + \Sigma \frac{O}{(1+i)^t}}$$

As explained by Robert Haveman, "B is the expected annual benefit in the form of additions to national income from a project; i is the rate of interest used to discount the future streams of benefits and costs; t is the estimated life of the project (50 years); K is the fixed investment cost; and O is the estimated annual operation, maintenance and repair costs."[14]

This equation went into operation in 1936, but the Corps steadily modified and refined it in order to obtain more accurate measurements of projects. New criteria included secondary benefits, associated costs and price levels. Empirical data may be used. In recent years environmental values have been examined. In the case of the Trinity project the FWD studied not only the cost of constructing the canal, plus maintenance and operation for fifty years, but also bridges needing to be relocated or modified. Benefits included chiefly the savings accrued from the less expensive freight rates, flood control and recreation.[15]

The complexity of the analysis is shown by the range of items that must be included and the difficulty in affixing a monetary value on them. Nearly every project, reservoir or canal, alters the physical characterestics of the land. What is the monetary value of a national tributary used by hunters and fishermen compared with the value of that same tributary drained or channelized for the sake of flood control? Benefits of a canal depend greatly on the volume of expected barge traffic once the waterway is open. Non-federal sponsors of the Trinity canal believed, of course, there would be more than enough traffic to warrant construction. COST replied, however, that north Texas industry consisted

[13] Robert E. Haveman, "The Post-war Corps of Engineers Program in Ten Southern States: An Evaluation of Economic Efficiency," in *Essays in Southern Economic Development*, edited by Melvin L. Greenhut and W. Tate Whiteman, (Chapel Hill, 1964), 454-457.

[14] Ibid., p. 453.

[15] Robert Fickel, FWD Planning Branch, to D. Clayton Brown, Interview, February 7, 1978; Haveman, *Water Resource Investment and the Public Interest*, p. 22.

principally of electronics, commercial banking, insurance and defense, industries not likely to rely on water transportaion. How could one compare the cost of a reservoir with its benefits? The 1936 Flood Control Act states that if the absence of a project (flooding) adversely affects the lives and social security of the inhabitants, the project is justified. But environmentalists in Texas insisted that flood control could be achieved better esthetically and financially by prohibiting habitation on flood plains of the Trinity. Could deep wells be drilled for water supply instead of building a reservoir? In view of the lowering water table in Texas, that alternative does not appear feasible. Differing opinions in regard to the economic study of the Trinity project and others serve to illustrate the emotional disagreement over the benefit-cost analysis.

Separate from the monetary considerations in authorizing projects are two additional factors over which the Corps has no prerogatives: (1) regional economic development, and (2) [redacted] manipulation. Of the two the former has greater importance, which was true of the Trinity canal and many other projects in the United States. Federal stimulation of poorer areas began on a large scale in the 1930's, and the southern states, which long saw themselves as the victim of exploitative northern interests since the Civil War, zealously took advantage of the opportunity. A sense of bitterness was evident as seen in a statement by former Arkansas Senator William Fullbright on the subject: "New England has been exploiting the Southwest for 150 years. They have practically drawn all the capital from these areas into Boston. I see no public interest to help New England if we are going to be frank about it. It is not a distressed area compared to Arkansas and Alabama and Mississippi. We have been accustomed to handicaps since the Civil War, but we now feel that the other areas have been given a sufficient head start."[16]

For the proponents of the Trinity canal another consideration was imposed—rail rates discriminatory against the South, a practice detested by southerners and one which the canal sponsors complained about. Behind the push for a canal in Texas, therefore, was the desire to overcome the colonial economic status of the state. To the extent that the Corps becomes part of this

[16] Quoted in ibid., pp. 29-30.

larger matter, it serves, as stated by one writer, "as a conduit for Congressional revenue-sharing."[17]

Political manipulation, known as "pork-barrel" projects, has always been a feature of congressional politics. To quote former Illinois Senator Paul Douglas: "The only way a congressman can get his own project included in the final bill is to make an open or tacit agreement that he will support similar, if less meritorious, projects advanced by his colleagues."[18] Inherent in this statement lies a major charge of critics—that for the sake of impressing their constituents, congressmen exploit the environment and forever destroy wilderness and natural beauty. And high-ranking officers of the Corps, adept at bureaucratic maneuvering, take advantage of the situation and sell needless projects in order to generate work for the agency.[19]

No clear answer to this charge has been developed. Each project, however, must pass through a series of reviews before it is approved. After completion at the District level, a proposal undergoes its first review at the Division office. If approved, and most are, the study is again reviewed at the Office of the Chief of Engineers. Finally it goes to the Public Works Committee in the House of Representatives. More projects are submitted than Congress chooses to approve, a point in favor of the lawmakers, but detrimental to the Corps. On the other hand it questions the influence of alleged lobbying by Corps officers. On some occasions, however, Congress orders the construction of projects or wants additions to them not recommended by the Districts. This last point was illustrated with the FWD when Congress ordered inclusion of an electrical power plant in the Sam Rayburn Reservoir, although at one time it was not warranted in the opinion of the District. Local interests trying to expand the supply of electricity for REA co-ops were chiefly responsible for that change. To what extent the Corps lobbies behind the scenes is, therefore, unknown. "Doubtless some members . . . have learned their way about in those labyrinths," wrote one observer,

[17] Quote in Florman, "Hired Scapegoats," *Harpers*, p. 28. For further discussion of the pursuit for federal funds in the South, see Charles P. Roland, *The Improbable Era: The South Since World War II* (Lexington, 1975), 14-15; Calvin B. Hoover and B. U. Ratchford, *Economic Resources and Policies of the South* (New York, 1951), 78-79; C. Vann Woodward, *Origins of the New South, 1877-1913* (Baton Rouge, 1951), 379-384.

[18] Haveman, *Water Resource Investment and the Public Interest*, p. 34.

[19] Drew, "Dam Outrage," *The Atlantic*, pp. 53-54.

"but it is clear that they have no real power, being dependent . . . on Congressional whim."[20]

Critics devoted considerable attention to the training and "mentality" of the Corps. Because of sloppy engineering by the Districts, they charged, cost estimates of numerous projects fall short, and taxpayers end up paying much higher prices for reservoirs and flood control projects than they were told to expect. "Failure of the Corps to practice objective and conclusive analysis," according to Arthur E. Morgan, first chairman of the TVA, was responsible for a large number of errors in estimating costs and benefits.[21]

At the root of the problem, the argument continued, was the "military mentality" forever imbued into the minds of Corps officers at West Point. The bulk of officers were products of the academy and were generally regarded as an elite coming from the top-ranked students of a well-known engineering school. Military and civil engineering have not been compatible because the former must follow "action-in-practice." Trained to react swiftly as combatants, militarists cannot wait for deliberate reflection or search for alternate solutions. By contrast the analysis of water projects must include careful scrutiny of the delicate balance of nature and a full measure of every alternative. West Point has even been likened to the *lingula,* a rare organism of the biological world that has remained unchanged for half a billion years.[22]

In reality the Corps of Engineers is a civilian agency. Even one critic said that the "military men in the civil works section . . . represent only a thin superstructure over a large civilian agency."[23] Numerically, civilians outnumber the military; the FWD has three executive military officers and over 1200 civilian employees. Military officers, furthermore, spend only three years at a District as part of their career training; thus, division chiefs have administrative authority subject to military review. All legal disputes are resolved through the civil administrative boards or regular judiciary and not military courts. Rank and file engineers are a wide-spread representation of civilian engineering schools,

[20] Quote in Florman, "Hired Scapegoats," *Harpers,* p. 28.

[21] Arthur E. Morgan, *Dams and Other Disasters: A Century of the Army Corps of Engineers in Civil Works* (Boston, 1971), 30.

[22] Ibid., pp. 37-38.

[23] Drew, "Dam Outrage," *The Atlantic,* p. 53.

though most Districts, including the FWD, employ graduates from schools near them because engineering schools usually concentrate on water problems in their own area of operations.

In regard to the cost overruns, one of the most serious charges against the Corps, the FWD was accused of grossly underestimating the cost of Whitney Dam. Whitney was originally estimated to cost $8,350,000, but the FWD had spent $41,000,000 thru 1966, a cost overrun of 391 percent.[24] Research into the costs of Whitney, however, showed a different course of events. To be sure, approximately $42,000,000 had been spent thru 1966, but the FWD had anticipated that jump. The increase was also owing to fundamental changes in the dam.

The earliest cost estimate of Whitney was $20,000,000, some $11,000,000 above the figure cited by the critic as the original. It was the addition of the power facilities at Whitney which greatly increased the cost, plus the inflation of prices for a quarter-century. Construction was underway, of course, when the FWD took over the project in 1950, and in a special study of estimates on project costs conducted for Congress in 1951, the District estimated the total cost at Whitney to reach $42,043,900, a remarkably accurate figure. The FWD has committed errors, but the charge of the Whitney overrun was not accurate.[25]

The sudden unpopularity of the Corps in some circles may be explained by a change in its historic connection with a moral cause. As mentioned earlier, passage of the Flood Control Act of 1936 was partly the result of a campaign for multi-purpose planning. At the heart of that concept was low cost electrical power, an idea going back to the vigorous national debate of the 1920's over the federal power plant at Muscle Shoals, Alabama. Public power enthusiasts saw rivers as a natural source of energy to improve the standard of living for millions of Americans, especially in rural areas where only 10 percent of the families had electricity as late as 1935. For these idealists, reservoirs equipped with hydropower facilities were the answer.

Indicative of this motive was the origin of Texoma Lake just north of the Fort Worth-Dallas area and built by the short-lived

[24] Ibid. The Galveston District conducted the original estimate since it had responsibility for Texas when Whitney was planned. The FWD took over in 1950.

[25] Delbert Freeman to Chief of Engineers, June 13, 1951, Box 429, FWD Records Management Branch.

Denison District. When the Texoma reservoir was under consideration for approval, a spokesman for the project told the House Committee on Flood Control in 1930: "The greatest benefit that comes out of impounded water is the 'juice,' . . . you can light up that whole country and turn every barn into a factory by giving the farmers the power . . . we will milk the cows, run the refrigerators, rock the cradles, fry eggs and bake cakes with electricity."[26]

The Denison Dam with electrical generators was approved in the 1936 Act and went into operation in 1944. In the meantime several other reservoirs with hydroplants had been authorized in Oklahoma and Arkansas. In 1943, President Roosevelt created the Southwestern Power Administration (SPA) for the purpose of distributing the electricity generated at these dams—Grand River Dam in Oklahoma, Norfork Dam in Arkansas and Texoma Dam. More dams were added, all built by the Corps of Engineers, and over 50 percent of the electricity generated at them went directly to REA cooperatives in six states.[27]

The primary motive behind the Denison Dam and the creation of the SPA was the determination of agricultural interests to provide farms and rural homes with electricity. Rural electrification during the Depression had become a moral cause because less than one farm in ten had electric service; electrification was regarded as the single most important ingredient to end the drudgery and toil of farm life. In building Texoma reservoir and the others administered by the SPA, the Corps enjoyed the blessings of the public, for it was viewed as the agency, along with the REA, that would end the preindustrial rural life in north Texas and surrounding areas.[28]

The historical impetus for constructing many dams disappeared, however, once the hydropower sites were developed, and the Corps subsequently lost its moral supporters. A new ideology emerged, in Texas as well as other states, and moralists today view construction of a reservoir or canal as a gross injustice to nature and a danger to the benefits man derives from nature. The Corps is accused of carelessly exploiting the environment in

[26] Quoted in Brown, "Sam Rayburn and the Development of Public Power in the Southwest," *Southwestern Historical Quarterly*, p. 140.

[27] Ibid., pp. 141-154.

[28] Ibid.

such a way to threaten the next generation with a world physically and spiritually impoverished. Shortages of energy and water, according to the new ideology, must be resolved through consumer education and revaluation of the American lifestyle, that is, we should place less emphasis on abundance with its comforts and minimize our daily consumption of water, food, energy, minerals and other resources. This interpretation of resource use was the express purpose for bringing the environmental suit against the Wallisville Reservoir.[29]

On a much broader scale the same mode of thought was expressed in a widely discussed book, *The Limits to Growth* (1972). Written by a research team at Massachusetts Institute of Technology, it set forth a view of world economics that coincided with the environmental movement, that the global pattern of exponential growth cannot continue, and unless steps are soon taken to preserve resources and halt growth, catastrophe will occur. The industrialized nations in particular should strive for an equilibrium economy, that is, growth should not occur either in population, in productivity, in consumption or in any respect. As interpreted by one reviewer, equlibrium meant that "the rate of flow of recycled materials and raw minerals into new products exactly equals the rate at which old products are being scrapped."[30] This book received much attention and was heralded by some as the philosophy of the future and denigrated by others as just another doomsday forecast.

Similar books and articles appeared. Though each had a different approach, they had a common theme: exploitation and overconsumption of resources must stop. Opponents to the Trinity canal invoked the same argument, demonstrating that the fight in Texas was a microcosm of the same question throughout the United States. For the Corps of Engineers this new concept had significance because any project would alter the environment and also encourage growth. The justification for the creation of the FWD in 1950 was the catalyst effect that flood control and greater water supplies were expected to have on development. And the chief argument used on behalf of the Trinity canal was the industrial growth expected to occur once the waterway went

[29] *Audubon* (September, 1975), 133.

[30] Dennis Hayes, "Limits to Growth: A Look at No-Growth Economics," *National Parks and Conservation Magazine*, XLVI (October, 1972), 24.

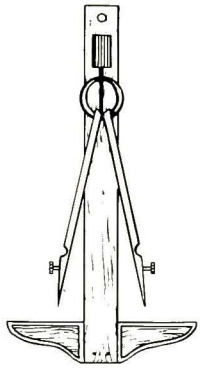
into operation. It was obvious, therefore, that the FWD as well as the entire Corps of Engineers faced new ideologies and concepts which ran counter to its *raison d' etre.*[31]

In some respects the Corps served as a scapegoat for some dissidents because several charges as illustrated with the FWD did not hold up under scrutiny. To some extent the Corps has been caught in the swift current of change—a rapid revaluation of American ideals that also challenged other institutions. The public has been rapidly moving toward environmental protection and stiff pollution controls, and within the less polemical literature there is a discernible drift toward a broader definition of the Corps' purpose—to be just as active as before and still concerned with flooding, water supply and use of rivers, but to devote greater attention to alternate methods of managing resources.[32]

By the mid-1970's the United States was in the throes of reassessing its economic and cultural philosophy dating to the period of early colonization. All agents of growth, whether in the public or private sector, were caught in the maelstrom of charge and countercharge, and regardless of any proposal made for resource management, one's opponent could produce his own alternative. Only a few Districts were embroiled in a controversy as heated as the Trinity waterway. Since it experienced the full brunt of the ideological attack against economic development, the FWD could figuratively pin another battle ribbon on its bosom.

[31] Anthony J. Wiener, "The Future of Economic Activity," *The Annals of the American Academy of Political and Social Science,* CDVIII (July, 1973), 47-61; "Develop-But Don't Grow," *Christian Century,* XC (June 6, 1978), 653-655.

[32] Brent Blackwelder, "In Lieu of Dams," *Water Spectrum,* IX (Fall, 1977), 41-46.



CHAPTER VII

Growth and Expansion 1960-1975

Throughout the ordeal of constructing the Johnson Space Center and the furor over the Trinity River canal project, the FWD handled less glamorous and dramatic projects. It built new reservoirs and erected or expanded military facilities. The latter were partly associated with the Viet Nam conflict and to a lesser extent with research. Civil projects, however, grew out of the need for water storage and flood control that was demonstrated by the drought of the 1950's and floods of 1957. Pressed by the shortage of water, the Texas populace continued to call for measures to ensure ample water, and the FWD inherited the task of building new reservoirs.

Indicative of the push for development was the establishment of the U. S. Study Commission-Texas. Approved in August, 1958, at the instigation of Senator Lyndon Johnson, the Commission was instructed to make a full-scale survey of water in the Lone Star State in view of promoting conservation, utilization and development. The Commission had to formulate a comprehensive development plan for consideration by the President and Congress. Each of the major river basins came under review: Neches, Trinity, San Jacinto, Brazos, Colorado, Guadalupe, San Antonio and Nueces. Except in those areas where these rivers flowed into the territorial prerogative of the Galveston District, they were wholly contained in the FWD.[1]

[1] United States Study Commission-Texas, *Part I, the Commission Plan* (March, 1962), 1.

THE STUDY AREA

U. S. STUDY COMMISSION – TEXAS

HOUSTON, TEXAS

LEGEND

RIVER BASIN BOUNDARY

INTERVENING AREA BOUNDARY

RESERVOIRS EXISTING OR UNDER CONSTRUCTION

NOTE

RESERVOIRS LESS THAN 50,000 ACRE-FEET NOT NAMED

RESERVOIRS LESS THAN 5,000 ACRE-FEET NOT SHOWN

30 0 30 60 90

SCALE IN MILES

N

OKLAHOMA

NEW MEXICO

ARKANSAS

LOUISIANA

MEXICO

Gulf of Mexico

RED

RIVER

LAKE TEXOMA

LAKE KEMP

WICHITA RIV.

WICHITA FALLS

LUBBOCK

WHITE RIVER RES.

SALT FORK Double Mountain Fork CLEAR FORK

ABILENE

HUBBARD CREEK RES.

POSSUM KINGDOM RES.

BRAZOS

LAKE J. B. THOMAS

BEALS CR.

N. Concho

ODESSA

LAKE BROWNWOOD

Pecan Bayou

SAN ANGELO RES.

SAN ANGELO

COLORADO

M. Concho

Concho Riv.

TWIN BUTTES R.

BRADY RES

Brady Cr.

River

San Saba

LAKE BUCHANAN

Llano River

N. Llano S.

GRANITE SHOALS L.

L. TRAVIS

AUSTIN

L. AUSTIN

Pedernales River

CANYON RES.

San Marcos Riv.

GUADALUPE

SAN ANTONIO

L. MEDINA

GUADALUPE RIVER

SAN ANTONIO RIVER

W. Nueces Riv.

Frio

NUECES

River

NUECES RIVER

L. CORPUS CHRISTI

Mission

Aransas Riv

CORPUS CHRISTI

Lavaca R.

Navidad River

San Bernard River

GALVESTON

PORT ARTHUR

BEAUMONT

LAKE HOUSTON

HOUSTON

ADDICKS RES.

BARKER RES.

W. FK. S. J. RIV.

L. FK. S. J. RIV.

SAN JACINTO

RIVER

LIMIT OF STUDY AREA

IRON BRIDGE RES.

CYPRESS

FERRELLS BRIDGE RESERVOIR

CADDO LAKE

Sulphur Riv.

TEXARKANA

TEXARKANA RESERVOIR

ELM FK.

Denton Cr.

Garza Little Elm Res.

West Fk

East Fk

LAKE BRIDGEPORT

EAGLE MTN RES.

LAVON RES.

FORNEY RES.

GRAPEVINE L.

FORT WORTH

DALLAS

BENBROOK RES.

CEDAR Cr. RES.

TRINITY

Richland Cr.

TRINITY RIVER

NAVARRO MILLS RES.

WHITNEY RES.

PROCTOR RES.

N. Bosque River

Leon Riv.

Cowhouse Cr.

Lampasas River

WACO RES

WACO

BELTON RES.

TEMPLE

LITTLE RIV.

San Gabriel R.

NAVASOTA RIV.

Yegua Cr.

TYLER

BLACKBURN CROSSING RES.

NECHES

Angeline R.

NECHES RIVER

SAM RAYBURN RES.

LIVINGSTON RES.

DAM "B" RESERVOIR

TOLEDO BEND RESERVOIR

LAKE CHEROKEE

EL PASO

RED BLUFF RES.

PECOS

RIVER

LIMIT OF STUDY AREA

RIO GRANDE

AMISTAD RES.

FALCON RESERVOIR

LAREDO

BROWNSVILLE

CANADIAN

RIVER

AMARILLO

Along with the Corps of Engineers, participating agencies included the Soil Conservation Service, Trinity River Authority, Texas Water Board, Texas Game & Fish Commission, Lower Colorado River Authority, municipal agencies such as the Chambers of Commerce, private corporations, and individuals. George Brown of Brown and Root Construction served as chairman of the investigating team. Although the Commission included a variety of subjects in its study, ranging from insect control to the economic future of Texas, the researchers focused on water supplies and the areas and means showing the greatest potential of development. The group finished its work and filed a report in March, 1962.[2]

A similar report had also served to justify new civil works. A special joint study prepared by the Texas Board of Water Engineers, the Southwestern Division of the Corps, the Bureau of Reclamation and the Soil Conservation Service had reported in June, 1958, that "the number one problem of Texas is recognized to be conservation, control and development of the State's water resources." As was the case with the broader study of the Commission, Senator Johnson instigated the joint report in response to the public demand for development after the prolonged drought. "Only within the past year," the report continued, "has Texas emerged from an extended drought which ranked with the eight major droughts of the past 600 years in severity and duration and resulted in critical water shortages in almost every portion of the state. This drought was broken by one of the most destructive flood periods on record."[3]

To combat droughts and floods, the message of both reports was clear: Texas must have new sources of water and the most readily available source was river impoundment. Throughout the state political and economic leaders shared the same sense of urgency, and when Texas congressmen lobbied for reservoir projects they had strong constituency support. The FWD was already in the process of completing three major dams—Somerville, Stillhouse Hollow and Proctor—in the Brazos Basin when Congress authorized additional structures in response to pressure from the Texas delegation: North Fork, South Fork,

[2] Ibid., pp. ii-viii.

[3] *Water Developments and Potentialities of the State of Texas*, 85th Congress, 2d Session, Senate Document No. 111 (June, 1958), 1.

Laneport, Navarro Mills, Bardwell, Blieders Creek, Wallisville and Tennessee Colony. Authorization of the latter two was related to the campaign on behalf of the proposed Trinity canal, but they received authorization, nevertheless, as part of the reaction to the drought.

Beginning in the early 1960's, therefore, projects of a varied nature converged on the District, for not only did it receive authorization and funding for new reservoirs and military projects but the FWD also began work on the Johnson Space Center. The feasibility study of the Trinity canal was also underway. During this period of intense activity, two officers of different style and personality commanded the District: Colonels R. P. West and F. P. Koisch.

Colonel West took command of the FWD in July, 1960. A native of the Texas Rio Grand Valley and product of Texas A&M University, he took over a large job. Military responsibilities of the FWD included the planning, design and construction at sixty Army and Air Force installations in Arkansas, Oklahoma, Louisiana and Texas. Civil work was starting in eight major river basins, from the Sabine in the east to the Nueces in the west. For fiscal years 1961 and 1962 five reservoir projects and one floodway were scheduled to start. Advance engineering and design was, of course, underway on other projects.[4]

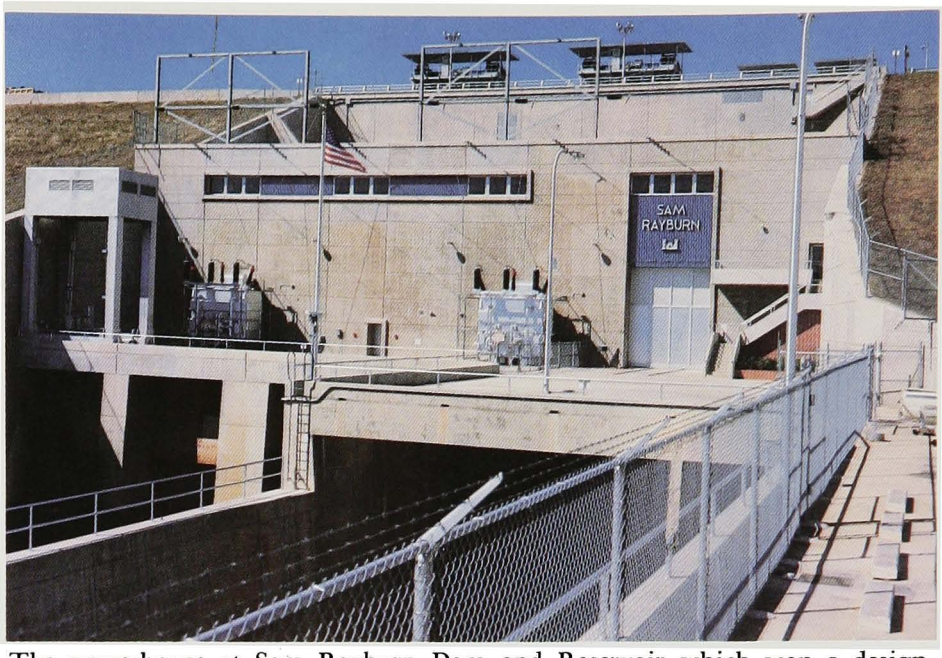
Colonel West brought a sense of urgency and energy to the District, not inappropriate characteristics in view of the workload of the FWD. Described as a "colorful character," he epitomized the eccentric in dress and mode of travel. Always traveling alone, usually in a bright red Austin Healy with no doors, he sped from project to project, "a trail of dust coming down the mountainside." The headquarters office frequently could not locate him and waited until he appeared again at another project. On one occasion he was scheduled to deliver a speech in Houston. Following customary procedure, Robert Craft, Chief Public Affairs Officer, had gone ahead to make arrangements. At the last minute Colonel West popped through the back door dressed in a black western outfit. A volatile man, the Colonel exploded in anger not infrequently. To cope with the taxing workload, West authorized overtime, and at one point the FWD

[4] "Notes for FWD History," Public Affairs Office, FWD.

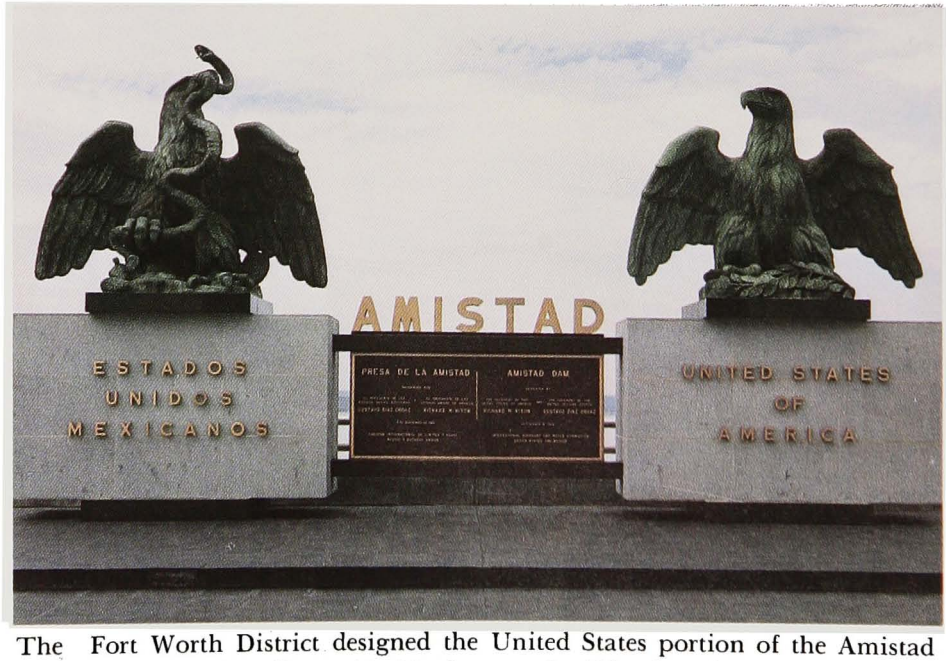
Lavon Lake is a popular gathering place for residents of the Dallas-Fort Worth Metroplex area.

The public is always welcome at Proctor Lake on the Leon River, Brazos River Basin.

Water sports are enjoyed by all at Benbrook Lake near Fort Worth, Texas.



The powerhouse at Sam Rayburn Dam and Reservoir which won a design award for the Fort Worth District.



The Fort Worth District designed the United States portion of the Amistad Dam--a cooperative effort with Mexico on the Rio Grande River

led all other Districts in the number of overtime hours. Employees remember him as a "doer," and morale reached an unusually high level during his tenure.[5] By contrast Colonel Koisch who succeeded West in November, 1962, was a reserved man, known as a "listener." Whereas West was volatile, Koisch was stoic. He also disliked the usual practice of weekly staff meetings and suspended them for three years, preferring to keep informed through other channels. The District had established a special area office at the JSC site in Houston which relieved much of the pressure on the executive office in Fort Worth. Koisch had an academic bent demonstated by his practice of keeping notes and writing small histories of major projects. In the case of the JSC, his history has become one of the chief documents on the project.

Since starting operations in 1950, the FWD had an excellent record, but it was marred with an incident known as the "Waco Dam slide." To provide the city of Waco with water, Congress had authorized construction of a roll-filled embankment 1800 feet long with a concrete spillway in the northwest section of the city on the Bosque River. Construction started in August, 1958, with completion scheduled for 1964. Work progressed smoothly until October 4, 1961, when an inspector on a routine examination discovered longitudinal and transverse cracks in a 1500-foot section of the embankment.[6]

The principal cracks were approximately 900 feet in length, but smaller ones occurred at the downstream "toe" of the dam. Observation points were quickly established and the fissures were monitored by FWD personnel. Gradual movement took place in the embankment between October 11 and October 23, but during a four day period, October 24-28, rapid movement appeared within the embankment and also at the downstream toe. No further sliding occurred. The area of movement coverd a 1000 to 1200-foot section of the embankment. In other words that section slid 22 feet vertically and about 21 feet horizontally (downstream). At the widest juncture the worst crack was 3 feet wide.[7]

Colonel West ordered a complete halt of the project, including

[5] Ibid.; James Herbert to D. Clayton Brown, Interview, April 25, 1978.

[6] Technical Liaison Division (PAO), typescript, November 22, 1961, Southwestern Division files.

[7] Ibid.

the spillway. He sent several investigation units to the scene and three private contractors to make subsurface investigations. Soil and rock samples were taken and subjected to laboratory analysis. Altogether 50 new test holes were drilled. Although the spillway incurred no damage, Colonel West wanted to be certain that its design had no defects. Fortunately the slippage occurred before the dam was finished and the reservoir filled.

News of the slide reached the public about three weeks later and set off a controversy. For one thing Colonel West allowed reporters on the site, but temporarily banned photographs. He assured the public, however, that the Corps had already started an investigation and was confident the dam would be safe. Three civilian experts had already agreed, he added, to examine the embankment and recommend remedial action. "We are embarrassed and unhappy about it and are not trying to minimize it," he stated, "but it can and will be fixed."[8]

His assurances did not settle the matter. Professor J. W. Dixon of the Geology Department at Baylor University informed reporters that a fault immediately under the dam was responsible. "It is so well known that our freshmen students for years have been taken there on field trips for purposes of illustration."[9] Location of the dam on the fault was therefore regarded as a serious error. Professor Dixon added that neither he nor his staff had been consulted by the FWD during the planning stages.

Specifically the pepper shale beneath the embankment was responsible, a point agreed upon by the Corps, the civilian consultants and Professor Dixon. The FWD was aware of the fault, but the shale, which was highly subject to movement, was too deep for the soil boring tests to detect. The shale was bounded by two ancient and inactive faults 800 feet apart. Developing high internal water pressure, the shale "acted like toothpaste in a tube when it is squeezed," according to Dixon. "It displaced itself and the strata above it sank, causing the embankment to collapse downward 20 feet."[10]

To remedy the situation the District had two possibilities: (1) to remove the dam and start over, or (2) implant earthen buttresses

[8] Dallas *Morning News*, November 21, 1961.

[9] Ibid., November 22, 1961.

[10] Waco *News-Tribune*, December 7, 1961; Brazos River Basin, Texas, Design Memorandum No. 2, Waco Reservoir, Bosque River, Texas, General, pp. 29-32.

A slide of 22 feet at the Waco Dam site.

known as "berms" to reinforce the dam. The FWD chose the latter. After removing some of the slippage, a large berm was placed against the structure downstream and upstream. The large cracks were filled with sand-bentonite cement grout. To keep watch on the dam, piezometers and reference points were installed. Downstream drainage ditches also extended along the fault zones. Construction of the spillway was resumed after engineers found no defects in it. In February, 1965, the Waco Dam was completed, one year later than originally scheduled. Repair cost ran to $3,000,000.[11]

Two other problems with the dam, though of less serious nature, bothered the District. As generally happens in the construction of a reservoir, several cemetaries became inundated, and the Corps arranged for removal of the bodies to another place. A Waco undertaker had contracted to perform this service, but was forced to store the bodies in his garage until the Cemetary Association would permit him entry into the new cemetery. Colonel West halted the further relocation of remains until the matter was resolved. The project was completed without further mishap.

No less perplexing was the incident concerning Brother Jim Phipps, owner of a large two-story brick house located on the project site. The FWD had purchased Phipps' land, but he preferred to retain ownership of the home and thus promised to remove it. Phipps delayed and delayed; at one point he installed the home on railway tracks and proceeded to remove his structure, but only a few hundred feet each week. He visited the District Engineer on several occasions, always using the reverend title of Brother Koisch or Brother Fickessen. It became a matter of practice for each succeeding District Engineer to inherit Brother Phipps from his predecessor. Mr. Phipps finally had to dismantle his house.[12]

Use of the berms corrected the slippage of the Waco Dam because no further movements or cracks have occurred. As a consequence of the slide, however, the FWD revaluated its procedures of geological and soil analysis and increased the number of employees in the Foundation and Materials Section of

[11] Report for General Wilson, typescript, December 11, 1961, Southwestern Division files; *Military Engineer* (September-October, 1963), 352.

[12] Craft, "History of the FWD," p. 202.

the Engineering Division. Greater attention has since been given to investigating the subsurface soils and rock formations in order to determine the natural conditions beneath the site of each proposed dam.[13]

During this period construction was underway on Sam Rayburn Dam, originally known as McGee Bend. Located on the Angelina River, the structure, when completed, formed the largest lake in the state and was the second dam in the District equipped with a powerhouse. Work had started in 1956, and the flooding of 1957 prompted Congress to appropriate funds for speedy completion of the project. Impoundment of water began in March, 1965, and the powerhouse went into operation the next year.

The power plant and outlet works were one of the first projects built on a sand foundation, meaning that the structure floats on sand below the water table. It was necessary to drill a ring of nine inch diameter wells around the site and pump them continuously for two years to keep the water level below the excavation. As the concrete was poured, the structure settled six inches, but rose three inches after completion when the pumping was stopped. For its work on this unique and demanding project, the FWD received the Distinguished Engineering Achievement Award in 1967.[14]

The period 1960-1965 saw the District engaged in smaller projects which were usually not within the defined responsibilities of the Corps of Engineers. In the late fall of 1964, President Lyndon B. Johnson spoke at Southwest State University at San Marcos. His subject was youth and employment. In that address he promised that nearby Army Camp Gary would be modified to become a Job Corps Training Center. The Camp had been used to train pilots. The first enrollment for the Center was scheduled for March, 1965, only a few months after the presidential commitment. The FWD received orders to deliver the President's promise.[15]

A crash program started. Contracts were awarded for 136 buildings during the Christmas holidays, and specifications had to be relaxed in order to meet the deadline. Colonel Koisch

[13] S. J. Stovall to D. Clayton Brown, Interview, April 20, 1978.
[14] Memorandum, Hassel L. Holder to D. Clayton Brown, June 27, 1978.
[15] Craft, "History of the FWD," p. 51.

appointed a special on-site task force to oversee the work. A full resident office was established at the site in February, 1965. Typical of the accommodations that had to be made was the procedure used when at the last minute the FWD received notice that another seventeen buildings had to be converted. District personnel simply walked through them with tape recorders, describing the work to be done. The tapes were quickly transcribed and handed to the contractor for a proposal. Costs were negotiated and forty-eight hours after the notification had come from Washington, the carpenters moved in.[16]

By spring, 1965, the project was far enough along for President Johnson to dedicate the Center on April 10, 1965. In September the last building was finished, and the FWD closed down the resident office. Final touches and maintenance were placed in the hands of the San Antonio Resident Office.[17]

Adding to the workload was the Amistad Dam located on the Rio Grande River about twelve miles above Del Rio, Texas. The United States and Mexico had agreed in 1944 to erect a reservoir, but work was delayed until 1961. That year the FWD began the advanced design and engineering of the dam. Since it was a cooperative venture using personnel from two countries, special procedural steps and requirements had to be met.

Engineering plans had to be prepared in both metric and decimal systems. Periodic meetings were held between designers of both sides, which required interpreters. And since the project was located on an international boundary, the specification called for gates and other devices to regulate pedestrian traffic. Penstocks were installed in the event that power generating equipment was later desired. By fiscal year 1965 the FWD had completed its design work. For two years the District maintained a resident office at the site, although the International Boundary and Water Commission handled the actual construction. In recognition of its contribution to the dam, the FWD received an Award of Merit for Engineering Design from the Chief of Engineers.[18]

The FWD frequently had to prepare rather innovative engineering designs to meet its responsibilities. Construction of

[16] Ibid., p. 51-A.

[17] Ibid., p. 51-B.

[18] Herbert to Brown, Interview, April 25, 1978; Notes of FWD Historical Committee.

Camp Gary Rehabilitation Project.

Completed dormitories ready for occupancy, Camp Gary Rehabilitation Project.

the Johnson Space Center was the most dramatic example. Exemplifying the less glamorous but still innovative work of the District was the modification of Lavon Dam located in the Fort Worth-Dallas area. Primarily a flood control project, Lavon had gone into operation in 1953. Several moderately sized north Texas cities depended on the reservoir for water and had organized the North Texas Municipal Water District. As the population grew in the vicinity of the reservoir, it became apparent that still more water was needed. In 1962 the Water District won congressional authorization to increase the size of the reservoir from 423,400 acre-feet to 748,200. The project had to be completed without interrupting the normal operations of the dam.

Enlargement of the dam was necessary. It had to be raised twelve feet, a relatively easy task as far as the spillway was concerned, but raising the concrete section of the dam was a different matter. To the Design Branch of the Engineering Division fell the task of finding a way to raise twelve tainter gates. It was also necessary to reinforce the dam to compensate for the extra pressure.

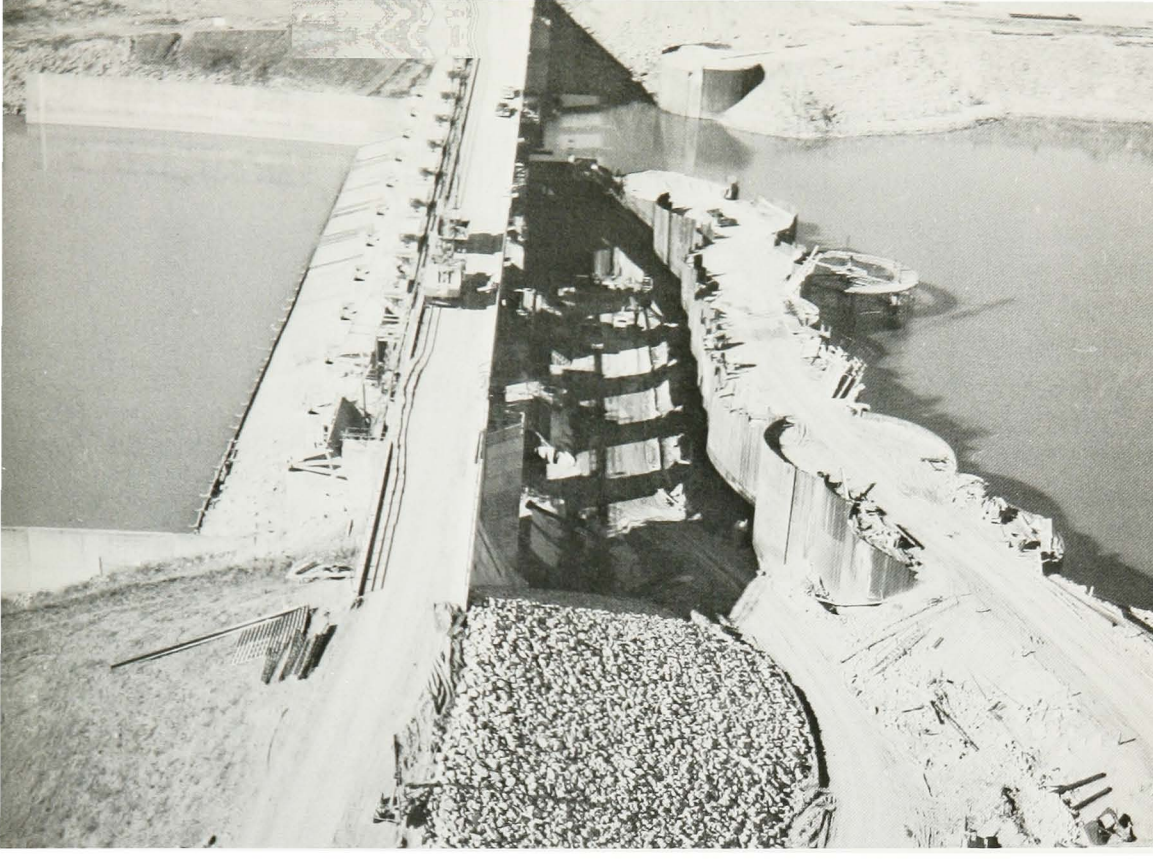
A coffer dam was built on one half of the dam at a time in order to keep the structure in operation. On the upstream side concrete was added to the face, up to an elevation of 476.5 feet on the left abutment and 481.5 feet on the right abutment. New concrete was also added at the top of the dam. In each case the new concrete had to be prestressed to the existing concrete. The tainter gates remained in position until the new reinforcement was finished. To meet any flooding only one gate could be out of service at a time. The spillway bridge had to be raised one span at a time.[19]

No mishaps occurred during the construction, and the project was finished by March, 1975. Because of the unique features of the job, engineers from other Districts visited the site to observe the work. Final cost of the modification, including the purchase of additional land and relocation of roads and bridges, was approximately $12,000,000.[20]

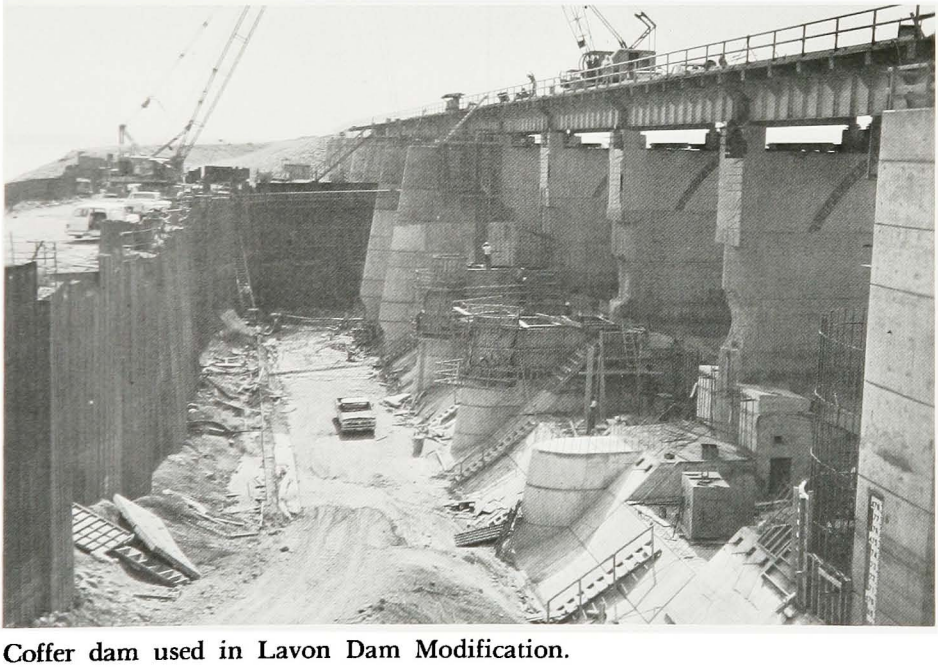
Accounting for much of the strenuous workload was a large amount of military construction. In 1961 the FWD assumed

[19] Garland E. Young, "Lavon Dam Modification," paper read before the American Society of Civil Engineers, San Francisco, April 10, 1973.

[20] Ibid.



Aerial view of construction to modify Lavon Dam.



Coffer dam used in Lavon Dam Modification.

responsibility for military projects from the following Districts: Galveston, Tulsa and Little Rock. Albuquerque also relinquished its military responsibilities in 1970, making Fort Worth the only District in the Southwestern Division having responsibility in both civil and military fields. Fort Worth received this new assignment chiefly because of its central geographic location in relation to the other Districts. The same administrative trimming was applied throughout the United States.[21]

In 1961 Brooks AFB in San Antonio was designated as the site for sophisticated medical-space research. As was the case with NASA and the Johnson Space Center, the Air Force called for an environmentally pleasing and attractive atmosphere along the lines of a university campus. Basic construction had started in 1959 on several buildings such as the Altitude Testing Building and Instructional Building. Beginning in 1961 the FWD supervised the design and construction of the Aviation Medicine facilities, including the Biosystems Research Laboratory. The Telemetry Data Analysis Laboratory was erected in 1963-1964. By late 1964 the School was finished, and although the FWD's part could not be described as a project in the "state of the art," the Aviation School had a different architectural style that the District regarded with pride.[22]

One of the largest single buildings constructed was the William Beaumont General Hospital in El Paso. The FWD inherited the project from the Albuquerque District when the latter relinquished its military construction. Nestled at the foot of the Franklin Mountains, the building is twelve stories high, consisting of an eight-storied tower mounted on top of a four-story base structure. Six floors of the hospital provide in-patient bedrooms with seventy-two beds per floor in private and semi-private rooms. Two nursing stations were placed on each floor and located near the private rooms where patients in critical condition were kept. The top floor consisted of neuropsychiatric in-patient, metabolic and clinical research facilities.

As much as possible the hospital conformed with the landscape. The Franklin Mountains, rising 7,192 feet, stood immediately behind the structure. Entrances were designed to accommodate and blend into the rolling landscape which varies

[21] William Edgar to D. Clayton Brown, Interview, April 27, 1978.
[22] Craft, "History of the FWD," pp. 161-164.

The William Beaumont Hospital at El Paso, Texas

from 3,935 feet above sea level at one point on the site to 4,245 feet at another. The main entrance is located on the third level where visitors enter over a pedestrian bridge. An open courtyard enabled the use of natural light and allowed the inclusion of terraces overlooking the courtyard. At the lower level were located a recreation room, post exchange, chapel and kitchen. Parking lots accommodated 700 automobiles. The FWD finished the hospital in 1972 at a cost of $17,500,000.[23]

Although the FWD's other military projects were not as challenging as the ICBM propellent loading system, some of them required, nonetheless, design innovations and precision engineering. Starting in 1972 when the United States switched to an all volunteer Army, the armed forces redesigned the living quarters of enlisted men in hopes of making military life more attractive. The FWD accordingly received instructions to redesign barracks located at Fort Hood, Fort Sill and Fort Bliss.[24]

Using a basic module plan guaranteeing each solider a minimum living space of ninety square feet exclusive of bath, toilet and storage, the FWD proceeded to remodel barracks. In nearly all the buildings central heating and air conditioning had to be installed. Usually partitions were sufficient to erect the desired quarters, but in some cases the District had to rebuild delapidated barracks.

Using a module concept designed by Lyles-Bisset-Carlisle-Wolff, each building was three stories high with quarters for twenty-four men on each floor. For each building a service module was built consisting of laundry facilities, mail service and vending machines. Each barracks complex, consisting of several buildings, had dining facilities, a gymnasium, chapel, and a headquarters and supply building. The project had considerable size as evident in the following number of buildings: Fort Hood 69, Fort Sill 57, and Fort Bliss 32. By the end of 1975 this project was 50 percent complete.[25]

The FWD undertook a similar project for the Air Force, though the original purpose was different. In order to save costs and promote efficiency, the Air Force wanted to experiment with relocatable buildings, that is, buildings that could be

[23] Ibid., pp. 165-170.
[24] Edgar to Brown, Interview, April 27, 1978.
[25] Ibid.

disassembled and put together at another location, usually another base. In 1972 the FWD received orders to carry out such a project on a nation-wide basis. Known generally as the Air Force Relocatable Industrial Construction Program, it consisted of three phases: warehousing, operations and administrative buildings, and housing. The latter constituted the bulk of the project.[26]

Starting in 1972 the FWD arranged with a private contractor to erect one warehouse in Atlanta and nine operations-administrative buildings scattered throughout the country. Housing structures were also constructed on bases throughout the United States with as many as ten buildings per base in some cases. At Dover AFB living accommodations were erected for 648 men. The award contracts on the Relocatable Project came to $38,000,000, but that figure did not include the cost of modifications. Each housing structure was a rectangular composite unit, meaning that the airman could sleep, eat and study in one building. Each room accommodated two men, and each person had a sleeping area of 100 square feet. Wood panel walls were substituted for brick. The project was finished in 1973, but no buildings have been moved yet which would test their relocatability.

Some difficulties arose with the Relocatable Project. The competition among bidders was undesirably low owing to the shortage of construction companies either equipped for such a project or the strong dislike among private builders for government "red-tape." Contractors generally had to enter into joint ventures with A-E firms which increased the probability of overlooked design areas. It was also difficult for out-of-region firms to be knowledgeable of local building codes, labor practices and environmental protection. Worst of all, however, the bidders proposed wood exteriors which the Air Force did not want, but would not refuse. Red cedar and redwood, the best wood for the intended purpose, were not easily available.[27]

On the other hand the project produced several advantages. The FWD realized design and related supervision savings of $2,000,000. The quality of the housing improved. Soldiers had

[26] Max Lechter to D. Clayton Brown, Interview, April 28, 1978.

[27] J. O. Robinson to Chief, Construction Division, July 29, 1976, FWD Construction Division files.

more privacy and larger accommodations equipped with carpeting, tub and shower, intercom, quality plumbing fixtures, improved acoustics and other features. In the final analysis the Relocatable Project was a success except that the Air Force disliked wood exteriors. But the project demonstrated the scope and diversity of military construction conducted by the FWD.[28]

Two projects which were not unique, but could be regarded as innovative were the Headquarters Building (Doughnut) at Bergstrom AFB and the Bulk Mail Center in Dallas. The former has been known as the "Doughnut" because of its circular shape with an opening in the center similar to the configuration of a doughnut. The Air Force drew the specifications for the building while Lyndon Johnson was President and was expected to keep an office in the structure upon his retirement from the White House. Instead he used his presidential library at the University of Texas.

Construction of the doughnut took only one year, beginning in 1967 and finishing in October, 1968. The FWD encountered no serious problems except with gaps in the floor sections, which proved to be a design error. Another design fault was the location of a mechanical room next to the Command Staff Room. Meetings in the latter were almost impossible because of the noise from the adjacent mechanical equipment. To remove the disturbance, a small six-foot wide storage area was built between the two rooms and lined with sound-proofing material. The small storage area served as an insulator and ended the noise. This change along with some modifications requested by the Air Force drove up the cost.

When completed the "doughnut" was 312 feet in diameter with an open light well of 180 feet in diameter in the center. Air conditioning and heating equipment were placed in the center "hole." Containing 123,210 square feet of floor space, the huge two-storied building proved to be efficient in use and accommodation.[29]

The Bulk Mail Center in Dallas was less impressive to the eye, but it was appropriately regarded as an unusual facility. To begin with, it was a large structure covering 8.2 acres and was 7/10's mile long. Employees used battery operated personnel carriers

[28] Ibid.

[29] Lechter to Brown, April 28, 1978.

School of Aviation Medicine, Brooks AFB, Texas.

The "Doughnut" Building at Bergstrom AFB, Austin, Texas.

and "walkie-talkies" to move around and communicate with one another.

Erection of the gigantic mail processing plant in Dallas was part of a nation-wide plan by the United States Postal Service to improve service for bulk mail. In 1970 when Congress created the Postal Service the latter acquired the authority to issue bonds for construction, thus freeing itself from congressional appropriations. The Postal Service quickly started plans to build twenty-one bulk mail plants and twelve smaller service centers. Expected to cost $1,000,000,000, the system would shorten mail delivery of bulk items from roughly six to two days. New York had the largest Center, a building covering twenty-five acres.[30]

The Postal Service requested the Corps of Engineers to handle construction since it was well experienced in such work. At the Office of the Chief of Engineers a special Postal Construction Support Office was established with field work handled by the regular Districts, and the FWD received orders to build the Center in Dallas. Usual procedures were followed, that is, standard procedures for advertising and awarding contracts were used. Robert McKee, Inc., was the building contractor.

Construction on the Dallas plant began October, 1971, and was scheduled for completion in March, 1975. Costing $34,000,000, the plant was designed to use high-speed equipment to route bulk mail for Texas, Oklahoma, half of Louisiana and part of Kansas. "It will be able to direct 547,000 parcels in a two-shift day," stated the construction supervisor, "which is 360 parcels a minute per machine."[31]

It was the features relating to high-speed equipment that the FWD regarded as innovative. Computers "read" 10,000 zip codes instantly and sent the mail to its appropriate chute. Consequently very little manual labor was involved, only for 20 percent of the total volume. About fifty equipment firms participated in the design and installation of the complex equipment. Among the twenty-one Centers in the United States, the Dallas Center ranked first in the processing of bulk mail.[32]

The high level of activity tapered off toward the end of 1965 when the District completed its work at the Johnson Space

[30] *Military Engineer* (July-August, 1972), 262-263.

[31] Dallas *Morning News*, April 29, 1974.

[32] Roland Morris to D. Clayton Brown, Interview, May 4, 1978.

Center. Several major dams such as Canyon, Stillhouse Hollow, Waco, Bardwell, Proctor and Navarro Mills had recently been completed along with some military projects. Employees had seen the reduced workload coming and began transferring to other Districts or federal agencies when they found an opportunity. Retirees were not replaced, so that through the process of attrition and transfers the number of employees fell from a peak of 1250 to approximately 950 by 1966.[33]

During the low ebb in the number of employees the headquarters moved to a new location—the Fritz Lanham Building in downtown Fort Worth. The city desperately needed a federal building to house the various agencies in the area, and as soon as it was available the FWD moved. Plans for the move from Vickery Street, about ten blocks away, were made in advance with precautions taken to ensure a smooth transfer.

The actual moving occurred on a weekend, beginning Friday. Moving companies brought the furniture and equipment to the respective new locations and tried to place it in the right spot. Many employees worked at night. Only a handful escaped the weekend duty, such as Gerry Mailloux who moved the Records Management Branch on Wednesday. Checkers were placed in three locations: the removal point of Vickery, the unloading point on Taylor Street, and the final resting spot for the furniture. Losses and damage were negligible. By Sunday the move was finished and no mishaps had occurred.[34]

Shortly after the move District Engineer Jack W. Fickessen announced that the headquarters offices would hold "swap day." His purpose was to match the furniture in the new premises and also to discard the last remnants of the old wooden desks and chairs from earlier days. Fickessen was quite insistent on this point, and ordered that at the end of "swap day" he did not want to find wood chairs matched with metal desks. He made no exceptions.

When the day came the employees scurried about, looking for a chair or table to complete their office setting. Each person had to fend for himself. In one incident two men left a large wooden table near the elevators during a coffee break, and when they returned it was gone. They never found it. Colonel Fickessen

[33] Minutes, Historical Committee, March 2, 1973.

[34] Lovena Deimel to D. Clayton Brown, Interview, May 2, 1978.

The new headquarters of the Fort Worth District, Fritz G. Lanham Federal Building, Fort Worth, Texas.

also encouraged employees to use personal items such as house plants and small decorative pieces to make their surroundings as attractive as possible. His "swap day" was a success and only occasionally did the Colonel discover a mismatched set of office furniture.[35]

The smaller number of employees was an advantage during the move, but their number rose until by 1975 the figure again reached about 1250. A considerable portion of the additions came from the Albuquerque District in 1970 when the FWD took over its military construction. About fifty employees came to Fort Worth, while others remained on field sites. Growth in the home offices forced some employees to move into the Oil and Gas Building and Federal Courthouse, ending the brief period when all were housed under one roof.[36]

Among its varied responsibilities the FWD also provided disaster relief in such catastrophes as the Waco tornado of 1953, Hurricane Carla in 1961 and the Lubbock tornado of 1970. The Waco disaster was the most deadly, killing 114 people and destroying a large portion of downtown. Personnel from the FWD had assisted with the clean-up, but at that time the Corps did not have legal right to enter private property, a restriction which severely hampered its ability to help because it had to wait on request for assistance. For the most part the District only conducted surveys and made structural inspections of damaged buildings.

On May 11, 1970, a tornado struck Lubbock, Texas, at 9:25 P.M. Maintaining a haphazard and discontinuous contact with the ground, it moved typically from southwest to northeast. The "twister" went straight through the downtown section. Leaving a path two miles wide and eight miles long, the tornado killed twenty-six people and injured over five hundred. Damage included both residential and commercial buildings, including a twenty story skyscraper and the city's utility plants. Over 460 homes were destroyed with another 489 damaged beyond repair. A total of 600 apartment units were demolished. In the final count 2,423 housing units were damaged.[37]

[35] Geraldine Mailloux to D. Clayton Brown, Interview, May 2, 1978.

[36] Deimel to Brown, Interview, May 2, 1978.

[37] U. S. Army Engineer District, Fort Worth, *After-Action Report: Lubbock Tornado 11 May 1970* (October, 1970), 1-2.

When the tornado disappeared into the night, a total of 251 miles of streets were filled with rubble and were impassable. One electrical plant was completely out of service and another operated at 45 percent of capacity. With no power, water could not be pumped. The power shortage probably saved lives by holding down fire and electrocution. Municipal services were also lost, including the city hall, the municipal garage and service center. One reporter said that Lubbock was a "dead city."[38]

Because of the devastating effect on the public services in the city in addition to the large amount of damage, Lubbock desperately needed help. When President Richard Nixon declared Lubbock a national disaster area on May 13, the FWD moved into the twisted ruin to help restore the city to normal. It received orders to clear debris and provide emergency repairs and temporary replacement of public utilities. It also had to make arrangements to clear debris from private property.

District Engineer Colonel Ralph S. Kristoferson flew to Lubbock with several staff members on May 13 to survey the damage. The District established a headquarters office in Hester's Office Supply Company at the corner of 15th and Texas Streets. Personnel from Fort Worth flew to the site, including an officer from the Public Affairs Office (PAO) to assist the media in the clean-up. Jack Shields of the Construction Division served as Resident Engineer, and Roland Morris was the coordinator for federal, state and local public agencies. Altogether about twenty-five employees were temporarily stationed in Lubbock.

The District began to clear debris. Part of the damaged section included areas inhabited by Spanish-speaking families, and the FWD used bilingual representatives to obtain rights-of-entry and explain the Corps' role. Contracts were awarded to companies for clean-up work and for inspections and surveys. Total cost for the FWD's part in the relief project was $1,000,000.

Based on its experience with the Lubbock tornado, the FWD made several recommendations to handle future disasters. In the future it should quickly designate geographic sectors for clean-up areas, it should locate debris disposal sites, and it should make prompt payment during operations to private contractors. Rapid communication was also deemed essential. By mid-summer the

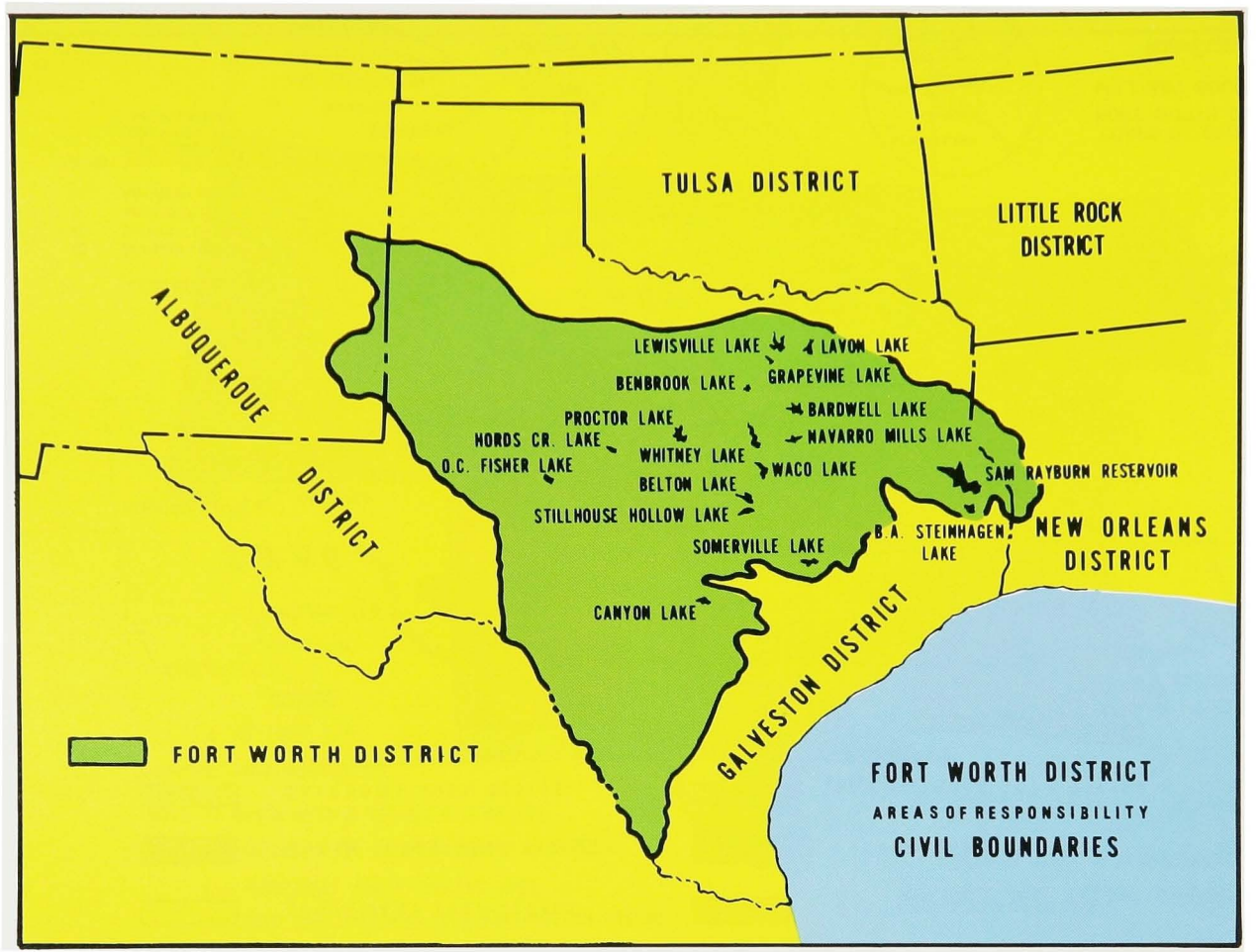
[38] Fort Worth *Star-Telegram*, May 12, 1970.

Destruction wrought by the Lubbock tornado, 1970

District's job was finished, and the last personnel pulled out on July 31, 1970.[39]

The experience with the tornado demonstrated the diversity of the District after twenty-five years of operation. In 1975 the FWD continued to rank as one of the largest Districts in terms of geography and volume of work. Several reservoirs were still under construction such as Laneport, North Fork and the Lavon Lake enlargement, and steps had been taken to build Lakeview Lake in the Fort Worth-Dallas area. The construction of barracks at Fort Hood, Fort Sill and Fort Bliss was still in progress. Environmental issues were quiet for the moment. Ironically the FWD expected to receive instructions to buy large tracts of acreage in the "Big Thicket" in order to preserve the site as a national park. Though viewed by some ecologists as an instrument of destruction, the FWD could in one sense look to the future as the guardian of the environment. It was clear by 1975 that the definition of civil and military projects as perceived by the Corps would undergo some future change.

[39] *After-Action Report*, pp. 26-28.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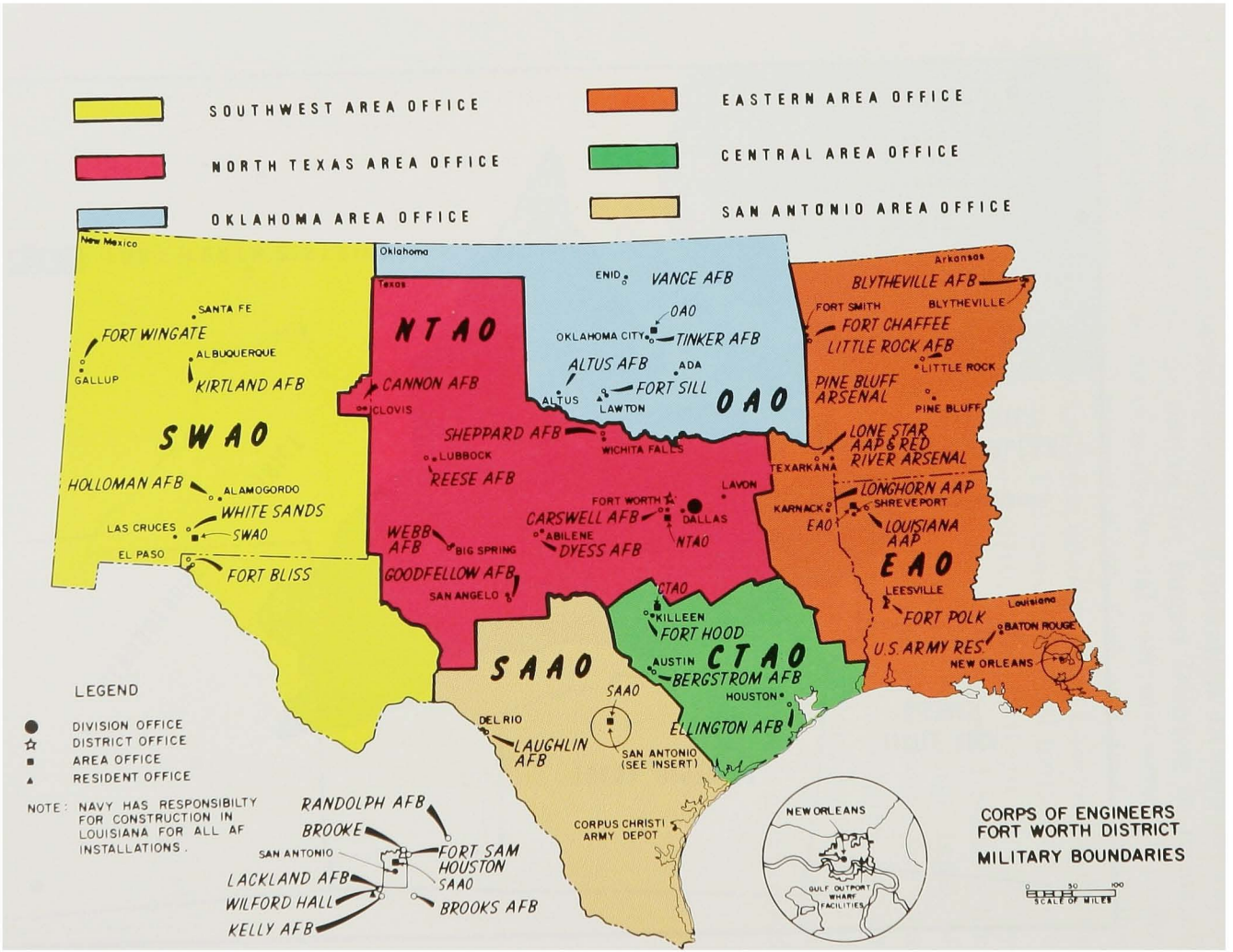
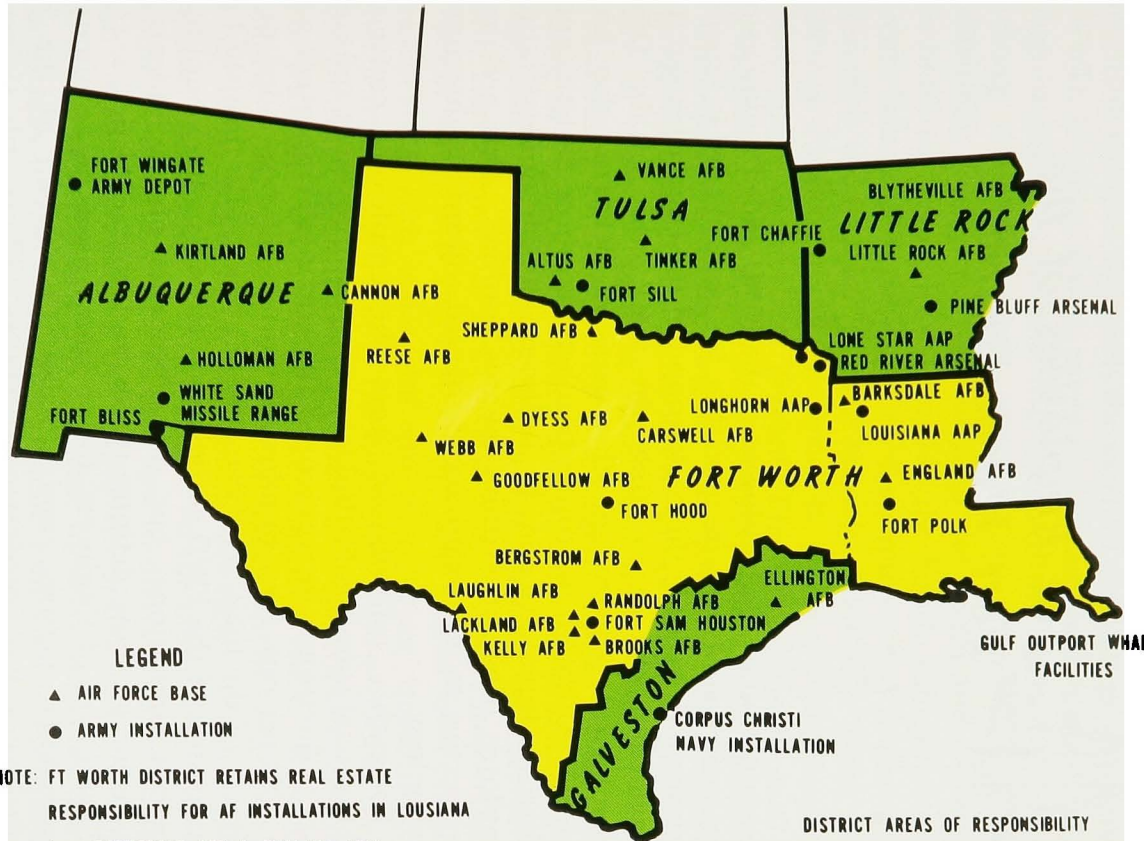
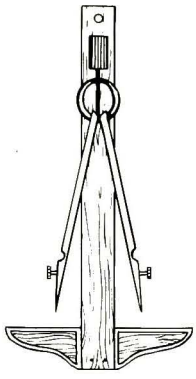
LITTLE ROCK DISTRICT
ALBUQUERQUE DISTRICT
LEWISVILLE LAKE
LAVON LAKE
GRAPEVINE LAKE
BENBROOK LAKE
BARDWELL LAKE
PROCTOR LAKE
NAVARRO MILLS LAKE
HORDS CR. LAKE
WHITNEY LAKE
O.C. FISHER LAKE
WACO LAKE
SAM RAYBURN RESERVOIR
BELTON LAKE
STILLHOUSE HOLLOW LAKE
B.A. STEINHAGEN LAKE
NEW ORLEANS DISTRICT
SOMERVILLE LAKE
CANYON LAKE
GALVESTON DISTRICT
FORT WORTH DISTRICT
FORT WORTH DISTRICT
AREAS OF RESPONSIBILITY
CIVIL BOUNDARIES


SOUTHWEST AREA OFFICE
NORTH TEXAS AREA OFFICE
OKLAHOMA AREA OFFICE
EASTERN AREA OFFICE
CENTRAL AREA OFFICE
SAN ANTONIO AREA OFFICE
New Mexico
Oklahoma
Texas
Arkansas
SANTA FE
FORT WINGATE
ALBUQUERQUE
GALLUP
KIRTLAND AFB
SWAO
HOLLOMAN AFB
ALAMOGORDO
WHITE SANDS
LAS CRUCES
SWAO
EL PASO
FORT BLISS
NTAO
CANNON AFB
CLOVIS
SHEPPARD AFB
WICHITA FALLES
LUBBOCK
REESE AFB
WEBB AFB
BIG SPRING
GOODFELLOW AFB
SAN ANGELO
FORT WORTH
CARSWELL AFB
DALLAS
ABILENE
DYESS AFB
NTAO
LAVON
ENID
VANCE AFB
OAO
OKLAHOMA CITY
TINKER AFB
ALTUS AFB
ADA
ALTUS
FORT SILL
LAWTON
OAO
BLYTHEVILLE AFB
FORT SMITH
BLYTHEVILLE
FORT CHAFFEE
LITTLE ROCK AFB
LITTLE ROCK
PINE BLUFF ARSENAL
PINE BLUFF
LONE STAR AAP & RED RIVER ARSENAL
TEXARKANA
LONGHORN AAP
KARNACK
SHREVEPORT
EAO
LOUISIANA AAP
EAO
LEESVILLE
FORT POLK
Louisiana
BATON ROUGE
U.S. ARMY RES
NEW ORLEANS
CTAO
KILLEEN
FORT HOOD
AUSTIN
BERGSTROM AFB
HOUSTON
ELLINGTON AFB
SAAO
SAAO
DEL RIO
LAUGHLIN AFB
SAN ANTONIO (SEE INSERT)
CORPUS CHRISTI ARMY DEPOT
LEGEND
DIVISION OFFICE
DISTRICT OFFICE
AREA OFFICE
RESIDENT OFFICE
NOTE: NAVY HAS RESPONSIBILTY FOR CONSTRUCTION IN LOUISIANA FOR ALL AF INSTALLATIONS.
RANDOLPH AFB
BROOKE
SAN ANTONIO
FORT SAM HOUSTON
SAAO
LACKLAND AFB
WILFORD HALL
KELLY AFB
BROOKS AFB
NEW ORLEANS
GULF OUTPORT WHARF FACILITIES
CORPS OF ENGINEERS
FORT WORTH DISTRICT
MILITARY BOUNDARIES
0
50
100
SCALE OF MILES


FORT WINGATE
ARMY DEPOT
KIRTLAND AFB
ALBUQUERQUE
CANNON AFB
HOLLOMAN AFB
WHITE SAND
MISSILE RANGE
FORT BLISS
REESE AFB
VANCE AFB
TULSA
ALTUS AFB
TINKER AFB
FORT SILL
SHEPPARD AFB
FORT CHAFFIE
BLYTHEVILLE AFB
LITTLE ROCK
LITTLE ROCK AFB
PINE BLUFF ARSENAL
LONE STAR AAP
RED RIVER ARSENAL
BARKSDALE AFB
LOUISIANA AAP
LONGHORN AAP
DYESS AFB
CARSWELL AFB
WEBB AFB
GOODFELLOW AFB
FORT WORTH
ENGLAND AFB
FORT HOOD
FORT POLK
BERGSTROM AFB
ELLINGTON
AFB
LAUGHLIN AFB
RANDOLPH AFB
LACKLAND AFB
FORT SAM HOUSTON
KELLY AFB
BROOKS AFB
GULF OUTPORT WHARF
FACILITIES
GALVESTON
CORPUS CHRISTI
NAVY INSTALLATION
LEGEND
AIR FORCE BASE
ARMY INSTALLATION
NOTE: FT WORTH DISTRICT RETAINS REAL ESTATE
RESPONSIBILITY FOR AF INSTALLATIONS IN LOUSIANA
(---- BARKSDALE AFB & ENGLAND AFB)
ALTHOUGH NAVY PERFORMS THEIR CONSTRUCTION MISSION
DISTRICT AREAS OF RESPONSIBILITY
MILITARY REAL ESTATE BOUNDARIES



CHAPTER VIII

The Employees of the Fort Worth District

Examination of the employees of the FWD added a dimension to the agency not otherwise available, for not only did it provide an opportunity to study the background of the employees but it also provided a chance to study the work ethic of the District. Sociological patterns in other areas of behavior also became evident. Although the connection between those patterns and the District's functions may be indiscernible, an understanding of employee behavior, within obvious confines, adds a humanist perspective to an organization oriented toward engineering and technology.

To gather information from the employees concerning educational training, birthplace, years of employment and similar data, a questionnaire was sent to all permanent employees, a total of 1280 persons. Four hundred fifty-nine (459) responded, or 35.8 percent of the total. The Personnel Division also furnished data. Discussion of the FWD employees based on such a sampling has obvious limitations, but the percentage of respondents was sufficient to show definite trends and characteristics.

The Corps of Engineers, for obvious reasons, is dominated by professional persons, and 179, or 39 percent, of the FWD employees had professional status. Their job titles and responsibilities varied from reservoir manager to interior decorator. Engineers of one kind or another accounted for the largest single group of professionals, especially since many management positions were filled by engineers. A relevant feature

of the engineers' background was their academic training since a widely read critic charged that the Corps was dominated by a "southern mentality." Southern trained engineers allegedly held little respect for the environment and therefore promoted projects with no thought for environmental consequences, or they blindly pushed for development owing to a lack of understanding humanistic values.[1] To assess the merit of this charge in regard to the FWD, employees were asked to indicate their birthplace and college or university where they received the Bachelor's degree.

Among the respondents, including professional and non-professional, 74 percent were born in the South and 54 percent were born in Texas. Births outside the South amounted to 26 percent. Some 53 percent of the respondents had a Bachelor's degree with the location of their schools as follows: Texas A&M University 15 percent; other Texas 45 percent; other South 19 percent; and non-South 21 percent. The South was "home" for three-quarters of the respondents, and that region also accounted for three-quarters of the degrees awarded to FWD employees. Numerically it was true that southern schools, though they varied widely in types of training, dominated the District.

Texas A&M University had the largest number of graduates working in the District, a point that would seem to reinforce the charge that the Corps depended too heavily on colleges in the South. Dependence on Texas A&M was, however, unavoidable. To begin with, it is the best known and staffed institution in Texas dealing with water and soil engineering. Institutions of higher learning, particularly the land grant colleges, focus on the varied problems peculiar to the people in their area of operations. Such was the rationale for establishing them. Resource management in Texas will hardly be researched or taught on the east or west coast. From this point of view, recruitment of personnel from Texas A&M was wise. At the same time, however, it would be unwise for the District not to diversify its recruiting.[2]

Job satisfaction among the employees appeared to be rather high if years of employment in private industry and other federal agencies may be used as a measurement. Employees were asked to indicate how long they had worked in private industry, other

[1] Elizabeth B. Drew, "Dam Outrage: The Story of the Army Engineers," *The Atlantic*, CCXXV (April, 1970), 53.

[2] Ibid.

federal agencies, the Corps of Engineers and the FWD specifically. Computation of the 459 questionnaires demonstrated a preference for the FWD. In other words employees, when measured by years of service, steadily migrated toward the District and seemed content not to move further. The current method of research would not, of course, take into account those employees who left or retired. In measuring the extent of employment, the average number of years of service were as follows: private industry 3¾ years; other government agencies 4¼ years; Corps of Engineers 9¾ years; and the FWD 11½ years. Employees clearly preferred the civil service, and they progressed through public agencies to the FWD.

These data clearly indicated a low turn-over rate for the District. Although job satisfication was not wholly measurable, it was not wholly inexplicable. A noticeable percentage of the respondents showed a strong enthusiasm for church and community affairs and similar activities. This high level of participation would be a cause and effect of the longevity of the employees of the FWD. Another factor might be the lower cost of living in the FWD's area of operations. Since civil service salaries were standardized nation-wide, the lower cost of living would give federal employees a slight advantage. For employees at reservoirs and other field sites the differential would be greater.[3]

Related to the low turn-over of the employees was the informality of the headquarters in Fort Worth. Although an intangible factor, informality, nonetheless, accounted for the apparent job satisfaction. Fort Worth, one of those cities known as "cowtown," is famous for its informality and citizens take pride in the quiet, easy-going atmosphere. This style of life crept into the District's home office where employees dressed informally, conversed easily with each other and generally enjoyed a cordial relationship among themselves. Informality generally extended to the relationship of supervisors with employees. The absence of rigid organization, though prerogatives were well observed, gave employees a sense of participation and a feeling they were part of the productivity of the District.

Such advantages could also be disastrous. Too much

[3] Membership in professional societies and church attendance alone were not regarded as community or church service.

informality, comfort and satisfaction would encourage stagnation, and the FWD would not keep abreast of innovations in its field of works, nor would it be able to hold public confidence. Since the Corps faces new critics each day, the FWD cannot afford to relax.

Some indication of the FWD's ability to remain "up-to-date" would come from the number of employees continuing their formal education. Among the 459 respondents, 14 percent had enrolled in courses at regular institutions of higher education. One member of the Engineering Division expected to receive the Ph.D. within a short time. Employees' pursuit of formal degrees, however, would not fully demonstrate the District's effort to stay in touch with advancements because the Corps, like all government agencies, regularly sends its employees to specially designed seminars and workshops for federal employees.

For the most part these seminars serve as the government's method for training employees. Attendance by FWD personnel has been high; 64 percent of the respondents indicated they have participated in the federal training program. While most probably attended a general workshop conducted for other agencies as well, some FWD employees attended special seminars held by the Corps. Aubrey Burkett, head of the Office of Legal Counsel, taught a resident engineers seminar, the only one of its kind in the United States.[4]

The District's contact with new thought and social trends, a difficult subject to analyze, rested in part on the employees' participation in community offices. A classic example was the public service of S. J. Stovall, mayor of Arlington. Elected to the city council in 1963, he served continuously until July, 1970, when he was elected mayor pro-tem. He filled the mayor's chair first in January, 1977, when his predescessor vacated the seat. And in April, 1977, Stovall was elected to his first term as mayor.[5]

His position as Corps employee and municipal leader promoted the public image of the FWD, for not only did he provide his employer with publicity but he also served as an unofficial liaison when the city of Arlington and the FWD had mutual concerns. The same effect occurred in the field where reservoir managers and park rangers participated in local affairs.

[4] Aubrey Burkett to D. Clayton Brown, Interview, May 18, 1978.
[5] S. J. Stovall to D. Clayton Brown, Interview, May 8, 1978.

Rangers proved helpful with scouting and other youth organizations. Because policy continues to be imposed upon the District from Washington, D.C., the influence that communities and employees had on one another had limitations. But community service should not be overlooked in assessing employees' exposure to socioeconomic issues even though it cannot be measured quantitatively.

Employees generally accepted and practiced the "work ethic," the social belief that diligence in one's daily routine was personally rewarding and beneficial to society. The United States has long been famous for its work ethic which was allegedly rooted in the Calvinistic tradition. In recent years, however, the work ethic has lost ground. Nation-wide surveys revealed that 39 percent of the population under the age of thirty would prefer not to work at all, a growing contrast with the 22 percent of 1962.[6]

Explanation of the work ethic at the FWD rests on several factors, some of which are probably indeterminable. But the District had eighty-one handicapped employees, or 6.3 percent, a high percentage compared with private industry, especially since a considerable portion of the District's positions involve construction and other field work. Handicapped persons generally perform well because of their difficulty in obtaining employment, and the presence of handicapped workers in the FWD may affect the other employees. Such a connection cannot, of course, be shown. But handicapped employees tend to be goal-oriented, a natural outgrowth of their life struggle to overcome a personal burden.

Combined with the engineer's mentality to reach a tangible goal, completion of a project, the attitude of the handicapped contributed to an atmosphere synonomous with productivity. The rural environment of employees in the field also promoted the work ethic because farming communities generally paid less attention to the concept of a forty-hour week. Since farmers are self-employed, they strive to maximize profits, and again the atmosphere in which a sizable number of the employees live is synonomous with energy and work.

As a historical subject employees were difficult to analyze. As treated herein they were an interpretive topic, and the research

[6] *National Review*, XXVII (October 24, 1975), 1192.

method employed for the discussion was not free of errors. But the evidence was sufficient to point in certain directions even though conclusions were unclear.

Job satisfaction appeared to be extant for reasons related to place of employment and for reasons related to the employees' private life. The informality of the headquarters office encouraged easy discussion between supervisors and employees as well as solely among the latter. Easy access to management personnel gave employees a sense of participation and a sense of belonging. The FWD personnel expressed satisfaction with church and community as indicated again by the large amount of participation. That factor plus the relatively lower cost of living made the FWD an attractive employer if years of service were any indication.

It was true that southerners comprised the bulk of employees. Approximately 75 percent were born in the South, and the majority of the professional class came from southern schools. No evidence surfaced, however, to show what effect the predominance of southerners had. Critics have insinuated that an undesirable "southern mentality" prevailed throughout the Corps, but they have not defined the term, nor have they shown it to be morally inferior. As an instrument of federal policy to develop the United States, the FWD at times served an interest much broader than the South, although that region benefitted most from its action.

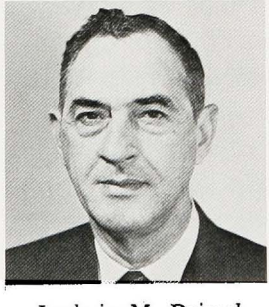
Changes in the work ethic of the District will likely occur. Throughout the United States employees in all walks of life exhibit less willingness to produce, and at an indeterminate future point that attitude will probably reach the FWD. If non-southerners continue to join the District, the agency's commitment to the economic development of Texas may weaken, although decisions about projects rest with local private interests and Congress. To a limited extent the various Districts of the Corps have influence in their respective area of operation, and if a shift occurs in the regional background of employees, the machinery for unpredictable change within this particular District may be established.

GALLERY OF DISTINGUISHED CIVILIAN EMPLOYEES

Gilbert H. Bodine
Office of Comptroller
Federal Service:
Sept., 1935 - Oct., 1969

Joseph C. Comito
Construction Division
Federal Service:
Feb., 1934 - Oct., 1969

Robert B. Crockett
Construction Division
Federal Service:
Oct., 1938 - Feb., 1971



Ludwig M. Deimel
Personnel Office
Federal Service:
February, 1934 - June, 1970

Jewell K. (Judy) Edgar
District Librarian
Federal Service:
April, 1942 - April, 1973

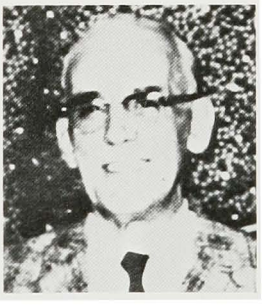
GALLERY OF DISTINGUISHED CIVILIAN EMPLOYEES

Arthur M. Hull
Engineering Division
Federal Service:
November, 1937 - July, 1975

Fred W. Johnson
Engineering Division
Federal Service:
October, 1933 - April, 1968

Charles Miron
Engineering Division
Federal Service:
July, 1931 - September, 1971

William E. Wood
Engineering Division
Federal Service:
June, 1931 - June, 1973



Oliver H. Wright
Construction Division
Federal Service:
July, 1932 - June, 1961

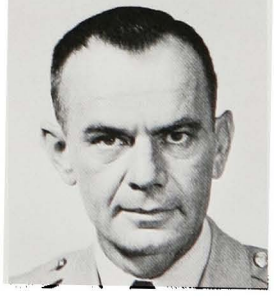
DISTRICT ENGINEERS 1950-1975

COL Delbert B. Freeman
April, 1950 - June, 1952

COL Houghton R. Hallock
June, 1952 - July, 1954

COL Harry O. Fisher
June, 1954 - August, 1957

COL Walter J. Wells
August, 1957 - July, 1960



COL R. P. West
July, 1960 - October, 1962

DISTRICT ENGINEERS 1950-1975

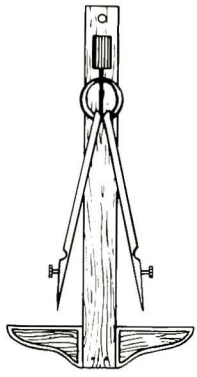
COL Frank P. Koisch
November, 1962 - July, 1965

COL Jack W. Fickessen
July, 1965 - July, 1968

COL Ralph S. Kristofferson
August, 1968 - August, 1971

COL Floyd H. Henk
August, 1971 - March, 1974

COL Joe H. Sheard
April, 1974 - July, 1976



CHAPTER IX

Conclusions and Future Directions

Since it went into operation in 1950, the FWD played an important role in the economic development of the Southwest. Texas had the potential at the end of World War II to become an industrial leader if sufficient water were available. Shortage of water had been a perennial drawback for the state since it was first inhabited, and to a limited extent transportation had also prevented economic growth. Through the support of the state's business and political leaders, and also its intelligentsia, the FWD received the responsibility to provide water.

Impoundment of rivers was the principal means by which water was stored. A vigorous program of reservoir construction had begun at the close of World War II, and it was the large workload of the Galveston District in north Texas that led to the creation of the FWD in 1950. By 1975 the latter had built or assisted in the construction of over two dozen reservoirs and floodways. Simultaneously Texas had overcome its water shortage, although, of course, municipalities had also built lakes. Industrialization and population growth mushroomed; the Lone Star state ranked eighth in value added by manufacturing and had the third largest population of the fifty states.[1]

An important but little-known part of the FWD has been its military construction which has grown remarkably since 1950.

[1] Bureau of the Census, *Statistical Abstract of the United States 1976* (Washington, D.C., 1976), 11, 775.

The District has responsibility for five states: Texas, Louisiana, Arkansas, Oklahoma and New Mexico. Most of these projects consisted of routine engineering and construction of barracks, runways, offices and similar structures. In some cases, however, military construction pushed the "state of the art" as exemplified by the design and erection of the Propellant Loading System of the ICBM's in the United States.

No project matched the Johnson Space Center in drama or research. From the beginning of the project in 1961, the FWD faced its greatest challenge, for not only did the District have to develop highly advanced technology at a feverish pace but it also had to work hand in hand with NASA, an agency faced with an almost impossible task—to place a man on the moon in less than ten years. Friction arose between the two agencies, but each should be commended for finishing a particularly demanding task on schedule, even though completion of the Environmental Test Chamber A was delayed. Compared with their accomplishments, the friction was minimal.

The industrial rank of Texas may place a new strain on the FWD. As industrialization continues, the state will probably need more water. But the population will likely become more conscious of the environment and expect the Corps of Engineers to resolve one without damaging the other. Pollution will take greater importance as increasing numbers of urban dwellers seek to preserve natural beauty and reduce spoilage of land and water.

Changes in public attitude in Texas represent a shift in ideology throughout the United States. When the FWD was started in 1950, the economic ideology of Texas was rooted in the frontier; it was an ideology of development, and the need for water in a semi-arid state had priority. But attitudes changed, and opposition to the District arose from environmentalists who questioned the impoundment of rivers and the construction of channels to control flooding. The furor over the Trinity canal project marked the beginning of that shift in attitude, and public opposition to water projects in Texas will almost certainly occur again, particularly if another push for the canal should come.

An expanded role for the Corps of Engineers and the FWD will likely come. Throughout the United States discussion of that topic has occurred, and the FWD's current District Engineer, Colonel John F. Wall, holder of the Ph.D. in civil and environmental engineering, has examined the possible future role

of the Corps. He suggested that each District attempt to keep in touch with the public by giving its executive officers the prerogative to interpret public opinion. "The Corps must be responsive to the needs of rural people," Wall wrote, and it must "increase urban orientation so as to cultivate more responsiveness to the needs of people."[2]

Colonel Wall suggested the establishment of research laboratories by the Corps of Engineers, which could not only conduct research but also facilitate the dissemination of information to Districts throughout the United States. Also desirable, he added, would be the development and adaptation of a regional land use policy that would recognize the trade-offs required. In other words, the use of irrigation for cotton in the Southwest "would be considered in light of agricultural effects in Mississippi."[3] Positive action in wastewater management was also mentioned, an area in which the FWD has some experience. In 1972 it assisted the State of Texas in the design of a wastewater management plan for the Colorado River Basin. Engineers arranged for lower quality water to be used for irrigation, thereby releasing higher quality water for human use. In 1973 the Environmental Protection Agency approved the plan.[4]

Some Districts will probably expand their roles faster than the FWD because the latter must still face the most persistent and critical problem in Texas history—lack of water. Although currently water supplies are generally adequate, thanks not only to the FWD but also municipalities, the state government and local water districts, water will almost certainly be in short supply in the western and some portions of the north central areas of Texas. The Lone Star state had become the energy center of the nation and a popular retirement location in the sunbelt. Both will promote industrialization, population growth and the need for water. Already counties in west Texas are running low on their underground supplies of water, an irreplaceable source. Continued growth in that area will jeopardize the economy and current lifestyle unless more water becomes available or consumers use less.

[2] John F. Wall, "The Civil Works of the United States Army Corps of Engineers: Program Modernization," (unpublished doctoral dissertation, Cornell University, 1973), p. 575.

[3] Ibid., p. 573.

[4] Craft, "History of the FWD," pp. 90-96.

Caution must be exercised, however, when forecasting future use of water. Predictions are generally based on the assumption that per capita consumption will remain the same, or increase slightly. These predictions are nearly always built on economic and population models based on thirty to fifty year patterns. Some forecasters warn of a disaster in the event of a severe drought. But changes in the models must also be considered, such as slower population growth, lower per capita consumption of water, a smaller rate of national income growth, slower or faster technological development, a higher price for water, federal policy and other variables.

The shifting attitude of the public toward river impoundment naturally makes the work of the FWD more difficult, and public attitudes must not be ignored. In some Districts, though not so much with the FWD, the atmosphere becomes charged with emotion and accusation during environmental debates, but cooperation among all interests becomes necessary if water is to be made plentiful. Imposed on top of the environmental issue is the lack of a clear federal water policy. Agencies responsible for water cannot always agree. Even the legislative and executive branches of the federal government differ with one another. If disagreement and opposition to alteration of the environment prevent the construction of more reservoirs, what alternatives are available?

Two frequently mentioned alternate sources of water are: (1) desalination and (2) precipitation augmentation (cloud seeding). Desalting plants are used in the United States, Latin America, Europe and the Middle East. The largest plant is in Kuwait and has a capacity of 30 million gallons daily (m.g.d.). Such a plant can provide water for a population of 150,000, including industrial use. In the United States the largest plants produce about 2-3 m.g.d. Costs are the chief drawback to desalination. In 1952 the cost was about $7.00 per 1,000 gallons, but in 1973 the figure was $1.00 per 1,000 gallons. But this figure remains prohibitive and will likely worsen as energy costs rise.[5]

Cloud-seeding might appear to be a source. The theory behind cloud-seeding is that under certain conditions a great deal of moisture will not yield precipitation because of the absence of small particles of crystal or chemical droplets. By implanting

[5] National Water Commission, *Water Policies for the Future*, p. 7.

silver iodide crystals into the clouds, precipitation becomes theoretically possible. Although it has worked in some parts of the United States, cloud-seeding has never succeeded in Texas and currently is not regarded as a feasible source of water.

Failure to develop alternate sources of water will necessitate reliance on the proven method—reservoirs. Compromise between ecologists and developers will have to be reached, for the expectation of water shortage grows each day. Dr. V. E. McKelvey, director of the United States Geological Survey, warned Americans to expect a shortage and added that it could be a "very severe problem in the future."[6]

Indicative of the growing awareness of the conflict between economic development and protection of the environment is the Rivers and Harbors Act passed in 1970. Congress directed the Corps to consider each future project in view of national economic development and the environment. Specific plans had to be drawn up showing the impact, for example, of a proposed reservoir on wildlife. In 1973 the Corps adopted a concept known as Principles and Standards (P&S) that broadened the considerations for each project. Each District had to consider not only economic development and environmental quality as national objectives but also the impact of projects on regional development and social well-being. Some of the impetus for these considerations came from the National Environmental Policy Act of 1969, but the more recent directives lengthened and refined the criteria used in water resource planning.[7]

Project planning must include, therefore, an analysis of all problems toward the development of a solution for the broadest public interest. Planners must examine a range of alternatives, including "no-development" plans which seek to preclude any significant form of physical alteration or construction and "nonstructural" plans emphasizing management measures rather than physical ones. In particular, planners consider nonstructural flood control measures to modify flood damage susceptibility by adjustments in land use and emergency preparedness as well as conventional structures such as levees and reservoirs to prevent

[6] Fort Worth *Star-Telegram*, November 30, 1977. For additional discussion of the complexities of water supply and global weather, see New York *Times*, August 8, 1974, p. 66.

[7] "Current Corps Planning Procedures," July 3, 1978, typescript, Box 1664, FWD Storage.

flooding. Executive Order 11988 provides force of law to avoiding floodplain development unless no reasonable alternative exists. During all phases of the planning process, consideration is given to recognized authorities, responsible professional judgments and other public expressions on environmental aspects which include, but are not limited to water and air quality, fish and wildlife resources, endangered species, aesthetic values and cultural resources such as archeological sites, historic places and remnants of resources that have scientific and educational uses.[8]

The complexity of planning procedures under the new criteria is obvious. Coupled with the widespread interest and awareness of the public, it becomes necessary for each District to work with interdisciplinary teams composed of individuals who represent a broad scope of expertise and can identify problems and needs of the public. Planners must identify and list features or conditions which should be enhanced, protected, preserved, restored or developed. That must be followed with assessments and evaluations including the environmental impact statement. Ultimately, alternate feasible proposals must be presented to the public, after which the plan which best represents the public interest is selected.[9]

For the FWD the future offers a real challenge. It must continue to fulfill its usual mission in resource management by helping provide water for the Southwest and controlling floods, but the District will be expected to accept new responsibilities such as wastewater management, protection of the environment and other tasks, some of which are still undefined. The complexity of the FWD's future, therefore, becomes obvious in view of the Corps' general guidelines known as Principles and Standards. Holding to the past while expanding for the future will be the District's mission.

[8] Ibid.
[9] Ibid.

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Robert Fickle	February 7, 1978
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Dale Powell	June 23, 1977
Ray Runder	June 22, 1977
Bud Rolfe	March 16, 1978
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